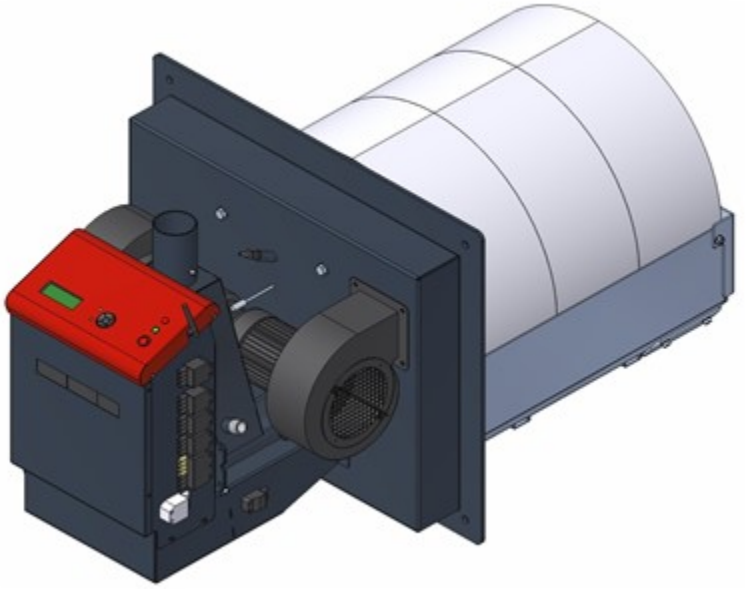
PV700a/PV1000a pellet burners

User manual

DK9401B1



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Safety precautions

- Do not start the burner before it is connected to the boiler and the boiler is connected to the chimney.
- It is recommended to wear a respirator while handling pellets.
- The boiler room where the burner is installed must fulfil all rules and recommendations given by authorities.
- All electrical connections must be done by trained professionals.
- No flammable materials must be stored near the burner.

Warnings

- Changing the construction of the burner without written permission from the manufacturer is forbidden.
- Use only spare parts provided or approved by the manufacturer in order to avoid any damage to the burner and dangers resulting from it.
- Welding is allowed only after disconnecting the burner from electric supply. The circuit board must be removed from the burner.
- Do not open any boiler door while the burner is in operation.

Notice

- Manufacturer of burners has right to make changes in construction of burner and its firmware.

Burner corresponds to following directives and standards:

Directive 2004/108/EC
Directive 2006/95/EC
Directive 2001/95/EC
Directive 2006/42/EC
EN 15270 2008
EN 230 2005
EN 60370-2-5 2002

Pellet burner PV 700a		No
Year of production	2014	
Electrical supply	230V	
Max heat input	20kW	
Emission class	5	
Noice emission	52dB	
Power consumption at stand-by	7 W	
Manufacturer: Pelltech OÜ, Sära tee 3, Peetri, Estonia		

Pellet burner PV 1000a		No
Year of production	2014	
Electrical supply	230V	
Max heat input	1000kw	
Emission class	5	
Noice emission	52dB	
Power consumption at stand-by	7 W	
Manufacturer: Pelltech OÜ, Sära tee 3, Peetri, Estonia		

DECLARATION OF CONFORMITY

We, Pelltech OÜ
Töökoja 1, 11313 Tallinn, Estonia
www.pelltech.eu

Declares under sole responsibility that the machinery described as

Pellet burner, Type PV 700 , PV 1000

to which this certificate applies, is in conformity with the standards or other applicable rules and regulations as mentioned below.

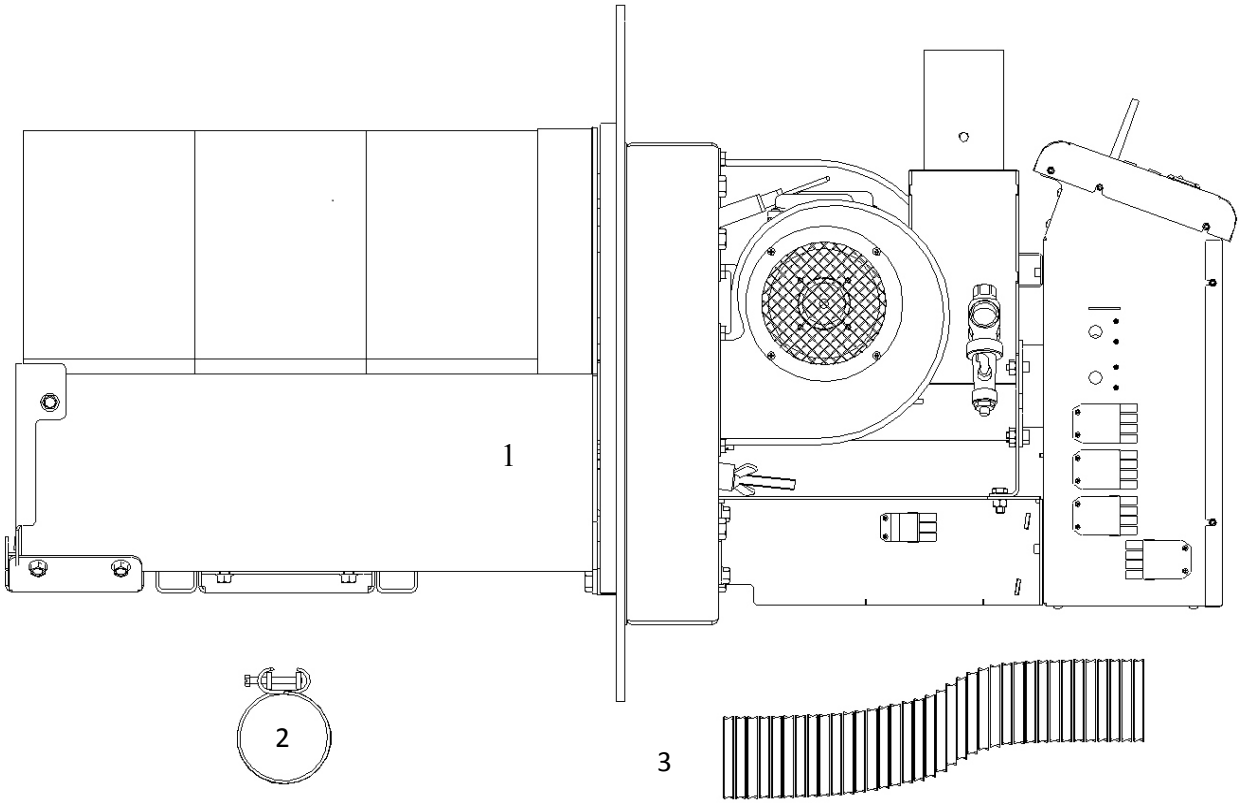
Conformity with the stipulations of:

EN 15270 2008
EN 230 2005
EN 60370-2-5 2002
Directive 2004/108/EC
Directive 2006/95/EC
Directive 2001/95/EC
Directive 2006/42/EC

Tallinn 10.06.2010

Aavo Isak, CEO, member of board

Set of components



1. Burner with burning chamber
2. Bracket 2 pcs
3. Hose 76mm

1 General description

PV700a and PV1000a are burners of wooden pellets (sawdust granules) that are intended to use in different boiler houses. Only wooden pellets with 6 or 8mm diameter can be used to run burners. You cannot use any other form of fuel but pellets to run the burner. Unique design of burners' burning chambers allows to burn also industrial pellets. The construction of the burners allows them to be used with different boilers: liquid fuel, solid fuel and universal boilers. The burner is connected to the boiler by using a connection plate.
The burner is equipped with a safety thermostat, a melting hose, temperature sensor, sprinkler system with pressure switch and auxiliary battery for protection against back-burning. Main technical data are given in Table 1 and Figure 1.

Table 1 Technical data of burner

Parameter	Unit	PV700a	PV1000a
L total length	mm	1190	1306
L1 housing length	mm	592	624
L2 burning chamber length	mm	590	682
ØD1feeder auger's tube diameter	mm	80	80
Pellet inlet tube diameter	mm	76	76
H total height	mm	598	621
H1 burning chamber height	mm	451	545
W burner housing width	mm	606	706
W1 burning chamber width	mm	528	614
Required chimney diameter	mm	300	350
Mass net/bruto	kg	150/185	230/280
Max amount of flue gases	M^3/h	1800	2500
Max fuel consumption	kg/h	150	213
Maximum/nominal power	kW	700	1000
Minimum power	kW	200	250
Hold flame power	kW	40	60
Noise level	dB	58	58
Emission class EN 15279	-	5	5
Operating temperature	C^o	-10…40	-10…40
Supply voltage	VAC	3x380	3x380
El power at ignition	W	1100	2100
El power, average	W	370	480
El power at standby	W	20	20

Main components of the burner and their locations are depicted in Figure 2 and described in Table 2 .

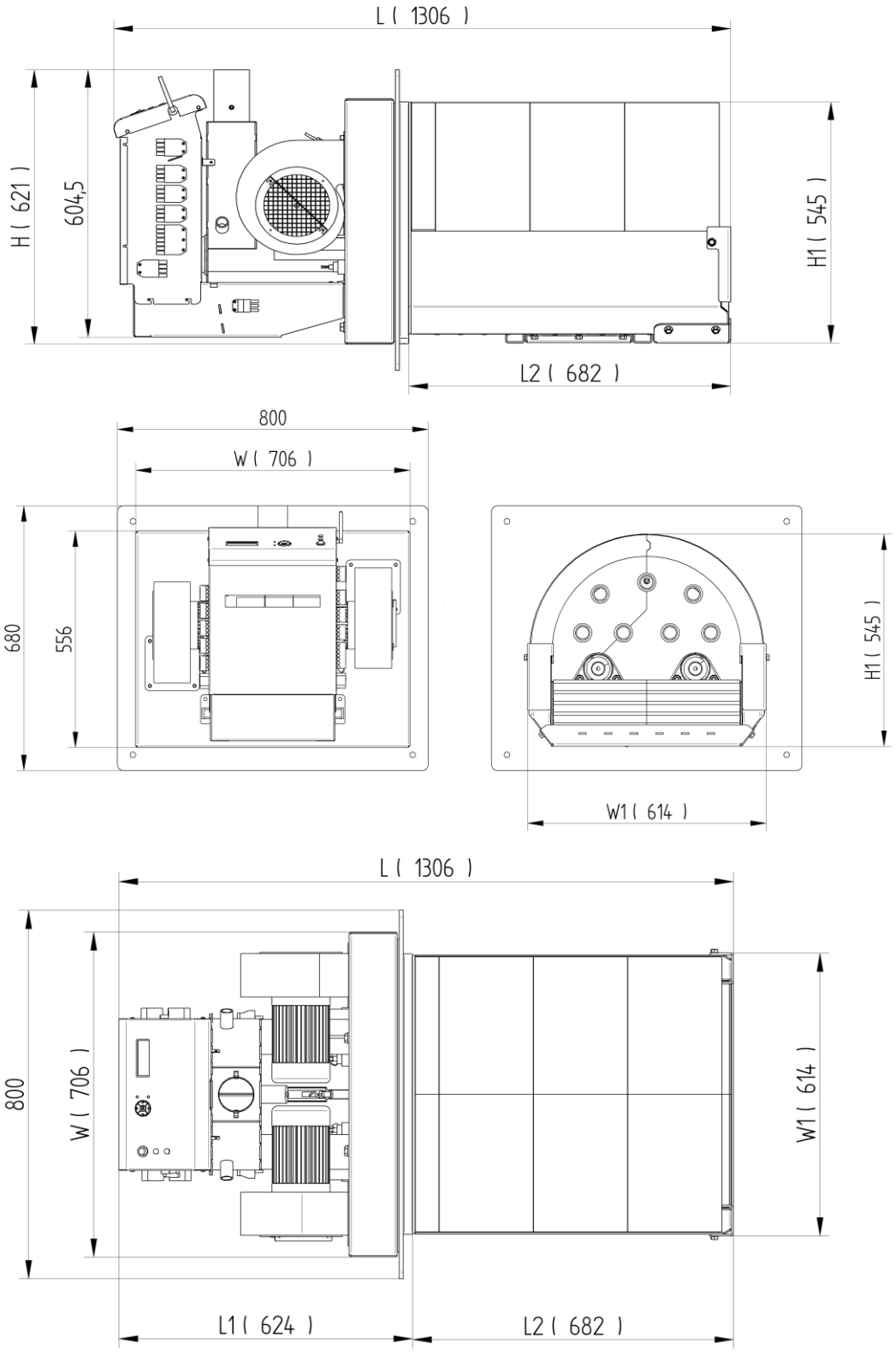


Figure 1 Main measurements of PV1000 burner

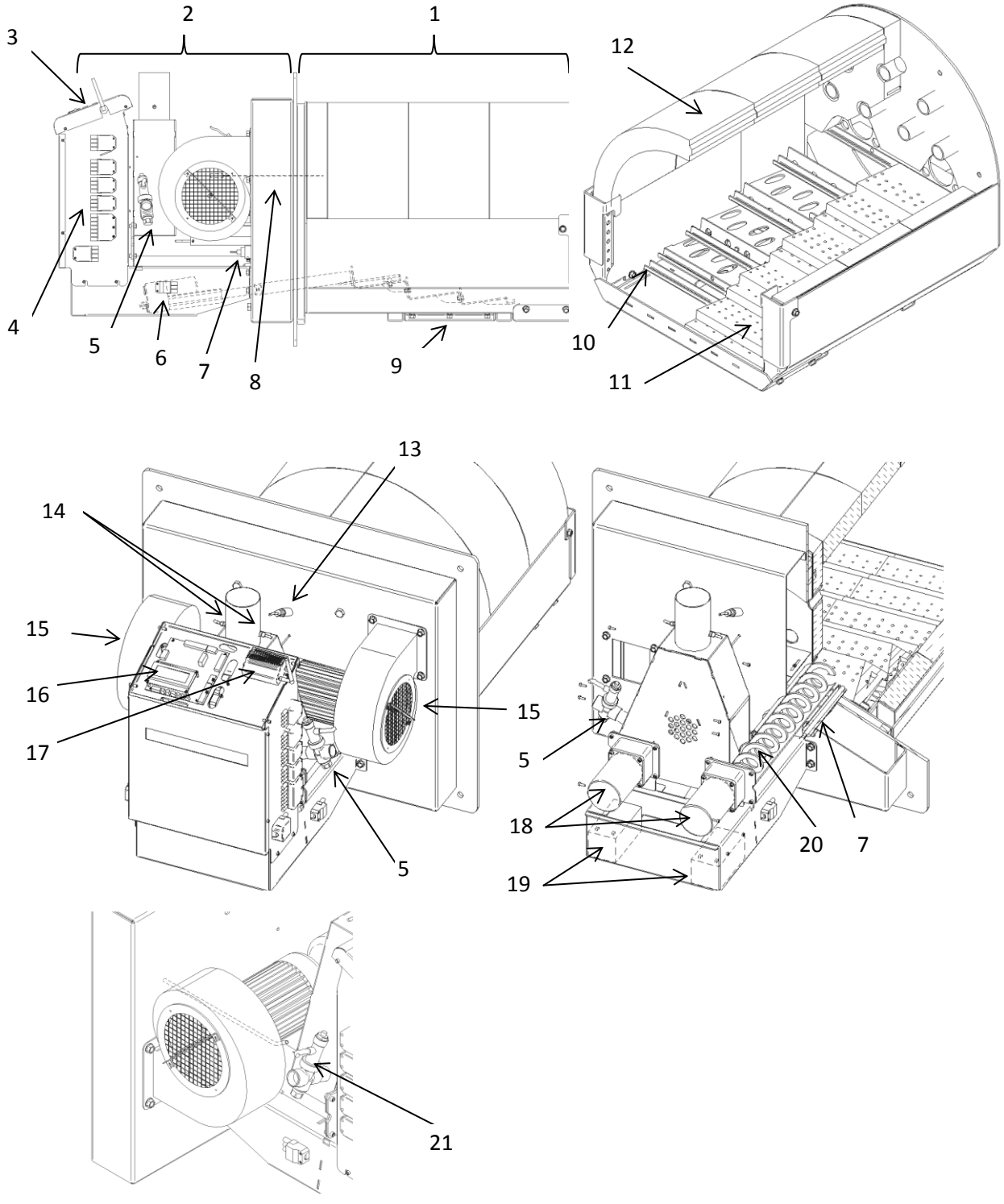


Figure 2 Main components

Table 2 List of main components

No	Name	Description
1	Burning chamber	The part of the burner that is inside the boiler and where pellets are burnt.
2	Burner body	The part of the burner that is outside the boiler and where burner's control and pellets supply takes place.
3	User interface	Control board with screen, navigation buttons and indication lights.
4	Control unit	Electrical- and control panel what contains inverters, fuses, relays, main controller board and other control devices
5	Water sprinkler	Sprinkler system will spray water to extinguish the fire in feeder's tube in case of back burning. The sprinkler system is activated only when the temperature of feeder auger rises dangerously high.
6	Grate cleaning motor	Linear motor moves the grates in burning chamber and pushes ash out from burning chamber. This cleaning cycle is made periodically. The interval between cleaning cycles can be controlled by PAR48. In each cleaning cycle, the linear motor pulls grates back then pushes the grates completely out. The linear motor has 75mm stroke and end switches for stop. Linear motor current limit can be set by PAR47. Linear motor is protected by fuse F10 what is installed on the controller board (board version BBB v2.1).
7	Igniter	Igniter´s purpose is to ignite loaded fuel making the burning process start. Igniter is installed on the burner together with igniter holding pipe. PV700 has 2 igniters and PV1000 4 igniters.
8	Brick temperature sensor	A sensor to adjust bricks' heat up speed according to temperature rise. Brick temperature rise speed control helps to reduce thermal stress of bricks and prolong their lifetime.
9	Cleaning hatch	Hatch below burning chamber to ease the removal of ash under the grates.
10	Grates support frame	Holds moving and stationary grates in correct position.
11	Grates	Burning of pellets takes place on the cast iron grates. Air needed for burning is blown to burning chamber via holes with different size. Burner has moving and fixated grates. Moving grates move periodically to clean the burning chamber.
12	Fire bricks	Burning chamber is surrounded with heat resistant from up and sides. Bricks are necessary for proper airflow and combustion.
13	Flame sensor	Photocell´s purpose is to recognize flame in the burning chamber.
14	Level sensor	Optical fuel level sensors recognize the fuel level in the vertical pipe. Fuel is recognized when pellets pass the optical beam between sensors.
15	Combustion air fans Left – primary Right –	 Primary fan blows main burning air needed for ignition, burning and gasification of the fuel. Secondary fan blows air through burning chamber back-wall and holds burning

	secondary fan	quality and optimal flue gas content. To control the burning procedure oxygen sensor (optional) for fan's speed regulation is used. Both fans rotation speed is measured by sensor, installed near the impeller axle. The sensor is reading magnetic field changes caused by magnet installed on the impeller axle.
16	Controller board	Controller board controls the burner´s burning process, by calculating fuel amount also feeder and auger work during burning process. Depending on the input signals from the sensors, controller makes necessary changes to the output states to maximize burning efficiency. Controller has a single control board.
17	GSM modem (optional)	A GSM modem enables burner to send SMS messages with various information of burner´s operating states (errors). GSM modem is located on control unit.
18	Feeder auger motors	Internal feeders are used to deliver correct amount of fuel into burning chamber. Delivered fuel amount is regulated by periodical work of feeder gear motors. 24V DC motors are supplied from backup battery to empty feeder tubes in case of power failure.
19	Battery	When there is no power from the main power supply then the burner is operating on battery power. PV1000 uses two 12V 3,4 Ah batteries. Because the battery is a safety element, the burner checks batteries condition and does not start the next working cycle if the batteries voltage is too low.
20	Internal feeder screw	Hollow spiral connected to feeder motor to transport pellets into burning chamber. Screw is not tightened to motor, but has small slack. It lowers the mechanical stress and expands gear motor lifetime.
21	Pressure sensor connection	Metal tube to connect pressure sensor input. Pressure sensor measures draught in burning chamber and enables the controller to regulate flue gas fan speed.

1.1 Safety devices

The back-burning is the biggest danger risk at burners working procedure. Back-burning appears when usual pressure or draught conditions have changed in boiler's combustion chamber. There are several reasons for such changes.

In order to secure operational and fire safety the PV700a/PV1000a burners are equipped with following safety devices:

- **Back up batteries.** Enable to finish safely burning procedure in normal conditions or during unexpected black out in mains supply.
- **Melting hose.** The external auger is connected to the burner with a special hose (Ø 76mm), which is made from easily melting polyurethane material that interrupts when back-burning takes place. Such measurement avoids entrance of the flame from burner into external auger and pellets container.
- **Thermostatic sprinkler valve.** Enables to extinguish the fire in feeder's augers tube by spraying water into it, when burner is overheated due to possible back-burning or any other reason.

- **Fire safety water pressure control switch (pressostat).** Enables to keep necessary water pressure in water reservoir and to ensure with that successful extinguishing procedure when needed. Pressostat switch allows starting the burner only if water supply is present and pressure exists.

1.2 Pellets

Wooden pellets or saw dust granules are concentrated and homogenized wooden fuel. Pellets are pressed with high temperature. No extra materials are added, pellets are held together by a natural ingredient found in wood – lignin. Pellets are neutral, renewable fuel. Its burning doesn't spoil CO_2 balance in the atmosphere. Not only premium but also the industrial pellets can be used in PV700/1000a. Pellets must be stored in a dry and ventilated room. Table 3 provides an overview of pellet properties and threshold values.

Table 3 Pellets' overview

	Premium pellets	Industrial pellets
Raw material	Sawdust, cutter shavings, stem wood	Forest, plantation and other virgin wood, chemically untreated wood residues
Calorific value	4700-5100 kWh/ton	ca 4700 kWh/ton
Volume weight	ca 650-670 kg/m^3	>675 kg/ m^3
Volume of 1 ton pellets	1.5-1.6 m^3	ca 1.5 m^3
Diameter	6-10 mm	6-12 mm
Length	3-5 x diameter	ca 4mm
Moisture content	8-10 %	ca 5 %
Ash content	ca 0,5%	ca 2%
To replace 1000 l light oil	ca 2 tons or 3 m^3	ca 2 tons or 3 m^3

2 Installation

2.1 Prerequisites to boiler and boiler room

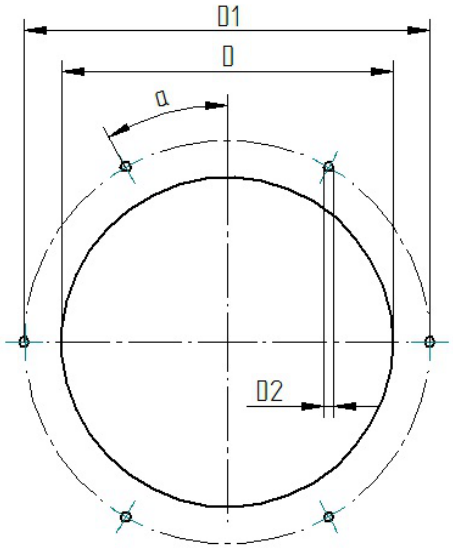
In order to install the burner, the boiler must meet to the following requirements:

- It is recommended to use three pass boilers.
- The construction of the boiler must make it possible to open the door of the boiler with the burner connected and removing ash from the furnace. If the door of the boiler is too narrow for opening it with the burner, then extra hinges must be mounted.
- If there is not sufficient (less than 5Pa) negative pressure in the furnace, a flue gas fan should be installed to improve the movement of the exhaust gases.
- The boiler must be installed into boiler's room in a way that there is enough space for cleaning the burner, the boiler, the smoke pipe and removing the ash.
- The burning chamber must not touch the bottom of the boilers furnace (min 10 cm distance needed).

- The boiler room where the burner is installed must fulfill all rules and recommendations given by local authorities.
- Boiler room must provide constant air supply of 1500 m³ per hour (ca. 1600 cm^2 air inlet opening).

In order to mount the burner to the boiler door, it must have mounting holes. See Figure 3 .

Notice! If the burner is installed to the boiler, the door's or the installation flange´s thickness should be 8-14mm.



Dimension	Unit	Value
ØD *hole for burning chamber neck*	mm	400
ØD1 *flange bolt ring diameter*	mm	490
ØD2 *bolt holes*	mm	6 x 13
Bolt hole offset angle	deg	30
Angle between bolt holes	deg	60

Figure 3 Boiler door mounting opening

Cutting contour of hole to be cut to boilers door in order to install PV1000 burner.

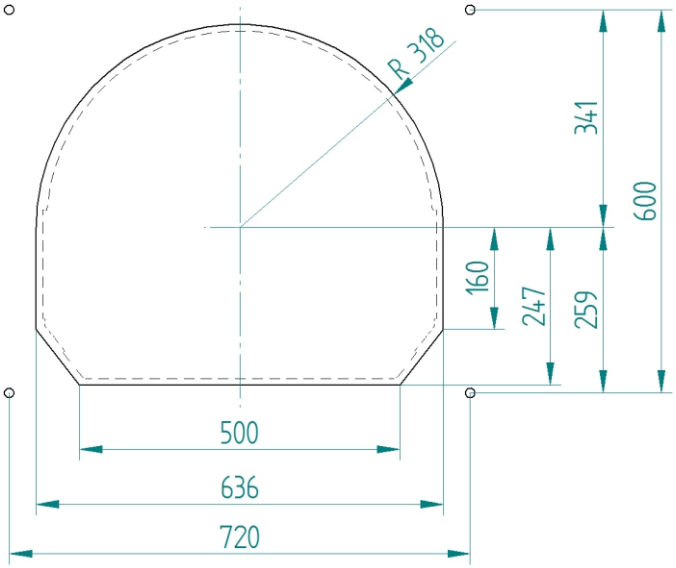


Figure 4 Contour of cutting

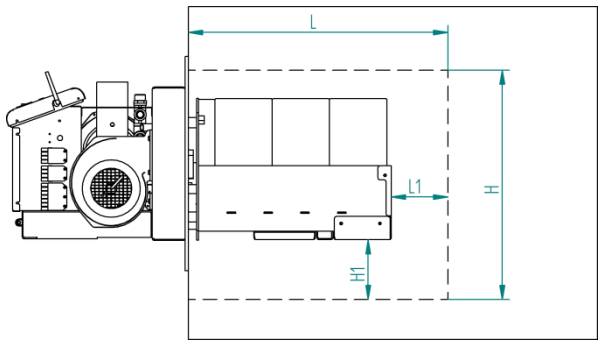


Figure 5 Firebox depth

Boiler's firebox depth L must be at least 2,5 times longer than the length of burner's burning chamber. Thus minimal length of the firebox L for PV700 has to be 1500 mm and for PV1000 1800mm. The height of firebox must leave at least 100 mm space (H1) for ash below burning chamber. Minimum dimensions: L1 ≥700mm; H ≥650mm. See Figure 5.

Pellet burners need regular cleaning and therefore boiler construction must allow easy opening of boiler's door without removing the burner. The minimum size of opening in boiler's door depends on the position of door hinges. Figure 6 below illustrates the situation. Point C is the critical point.
In order to keep door width minimum and boiler's door opening small, a double hinge solution can be used. As double hinges add another degree of moving-freedom, door must be fastened on both sides. Slide-out doors with guide rails is also an option.

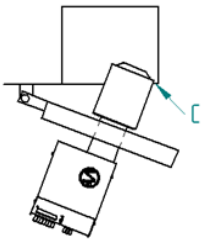
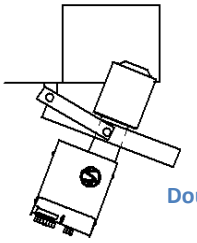


Figure 6 Burner has to reach off from boiler



Double hinges

2.2 Burner installation

Burners are delivered to customer in fully put together. Before mounting the burner to boiler it has to be disassembled i.e. bricks have to be removed and burning chamber separated from burner and air box.

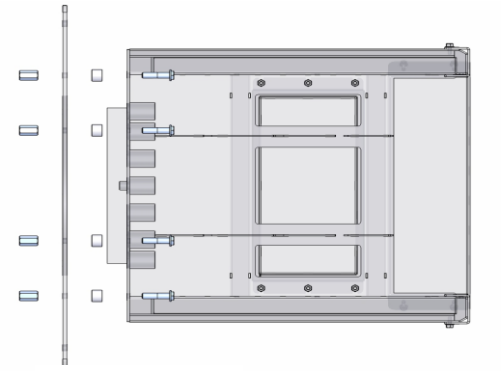


Figure 7

Mount the burning chamber on the inner side of the boiler door.

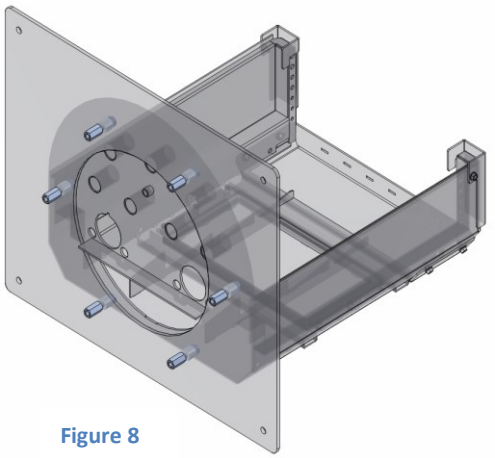


Figure 8

Use 6 M12x60mm bolts, spacers and distance nuts respective to the bolts.

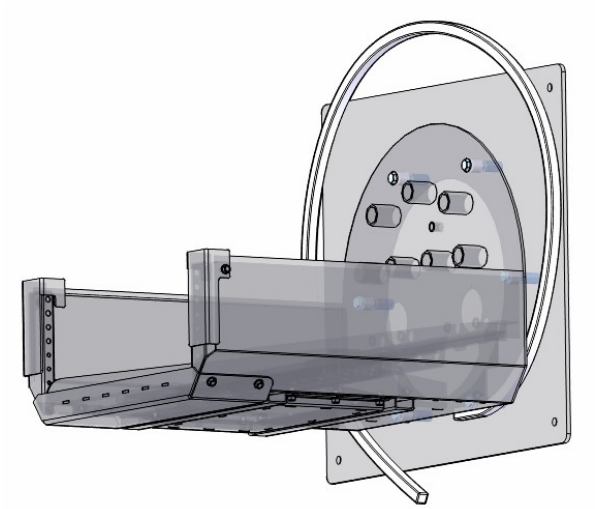


Figure 9

Install the insulation rope between the burning chamber and the boiler door. The rope must be installed near the outer perimeter of the burning chambers back wall.

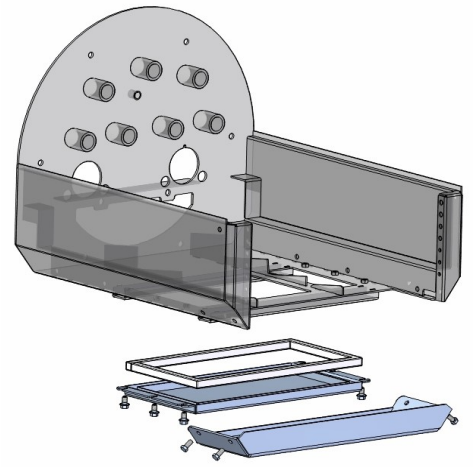


Figure 10

Grate holders installation

Install the burning chambers bottom panel (15x15mm insulation rope must be inserted to the slot in the panel) with 6 M8x16mm bolts.
Install the burning chambers front panel (heat shield), use M8x16mm bolts.

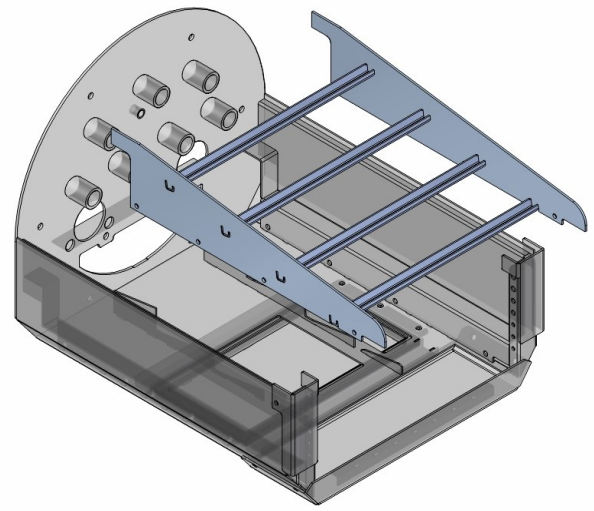
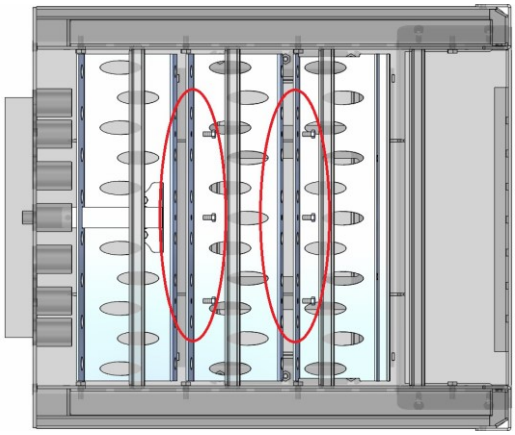
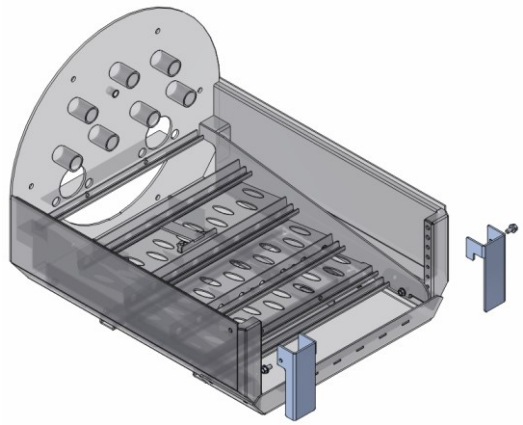
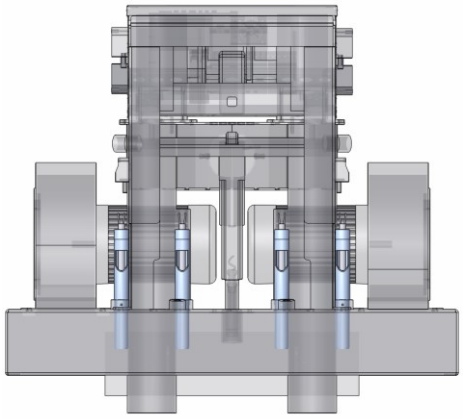
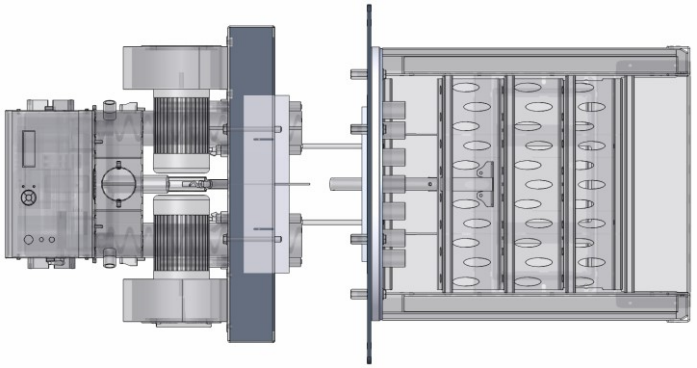
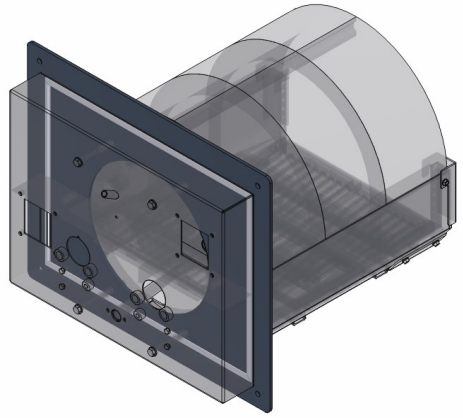
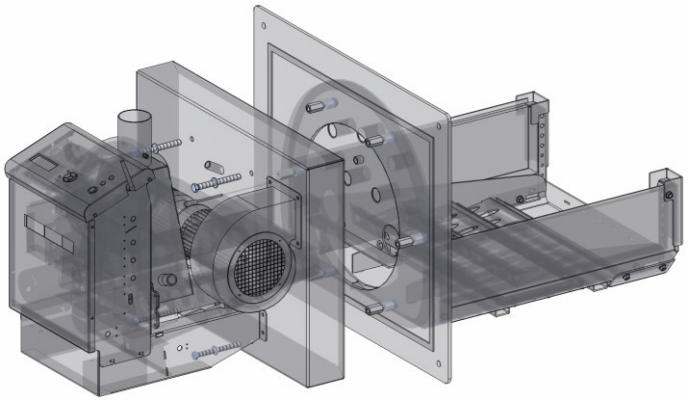
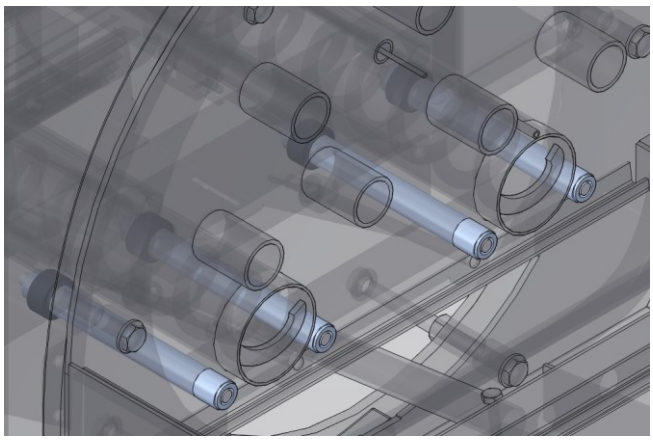


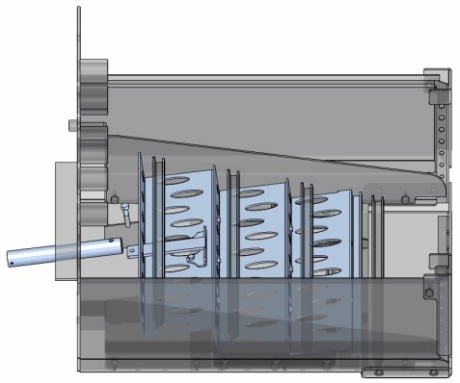
Figure 11

Connect the static grate holders with the side stone holders separately and install them together into the burning chamber as a frame. Fix them with M8x16mm bolts to the burning chamber.

 Figure 12	Connect the moving grate holders with M6x12mm bolts.
 Figure 13	Install the burning chamber's front brick holders, use M8x16mm bolts.

 Figure 14	Release the igniter tube screws and while inside the holders pull the tubes out about half of the total length.
 Figure 15	Move the air separator to its correct position (according to the boiler door thickness) and fix it with screws.

 Figure 16	Install the ceramic sealing strips on the boiler door. Fix them temporarily in position with any ordinary cellophane tape (scotch). Cut away the excessive sealing on the perimeter of the air chamber.
 Figure 17	Mount the burner's housing on the boiler door, using 4 M12x70mm bolts and respective washers.
 Figure 18	Push the igniter tubes through the burning chambers back wall and fix them in position with M4 screws.



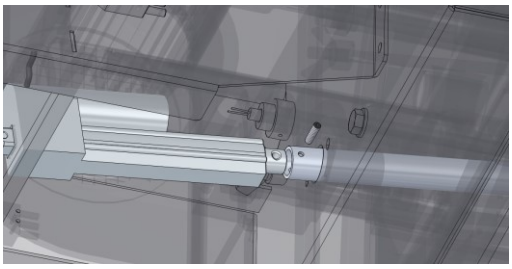


Figure 19

Connect the linear motor with the moving grate holder. Use 27x2,5mm pipe (length 240mm), M8x45mm bolt for the burning chamber side and a M6x25 socket set screw (DIN914 45H) on the linear motor side.

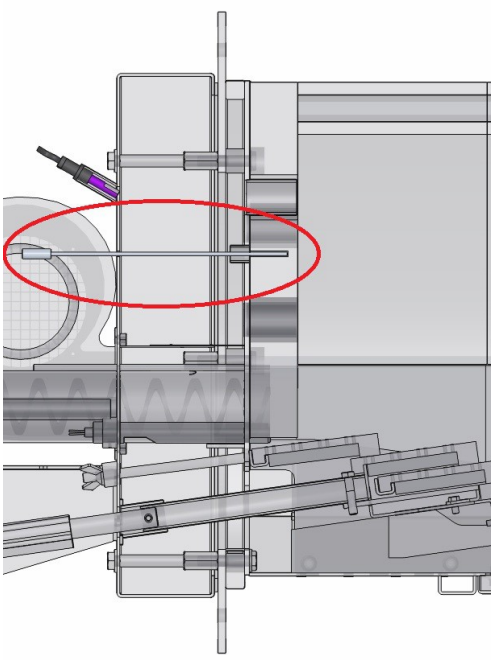
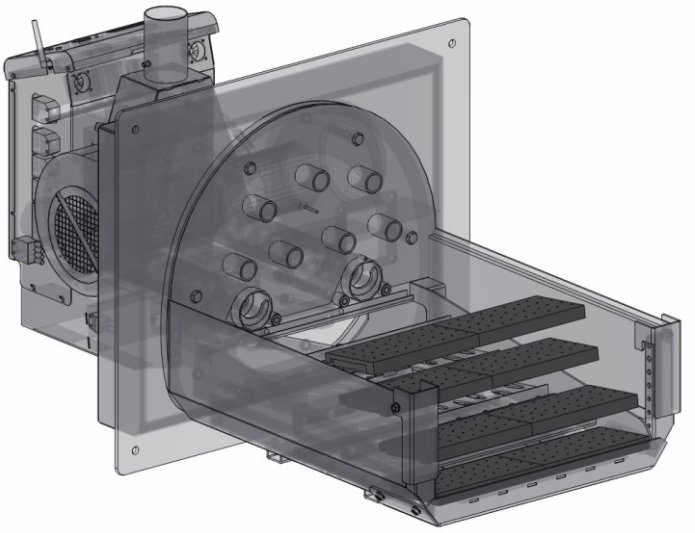
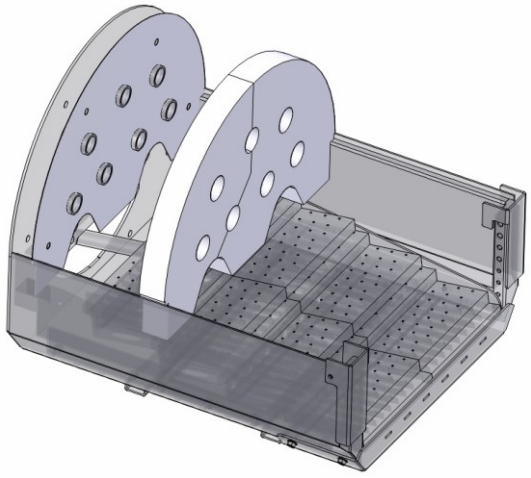


Figure 20

Push the stone temperature sensor through the hole in the burner body and the pipe on the burning chambers back wall, isolate it from the air flow (accessible from the burning chamber side) with ceramic sealing to prevent cold air from tampering with the measurements.

 Figure 21	Install the 2 lower position grates . Install the 8 middle position grates with 5mm holes . Install the 8 higher position grates with 7mm holes.
 Figure 22	Install the ceramic seal on the back wall of the burning chamber. Install the back wall stones on the burning chambers back wall. **Caution!** Be careful not to damage the temperature sensor! Push the stone temperature sensor into the opening in the back wall stone.

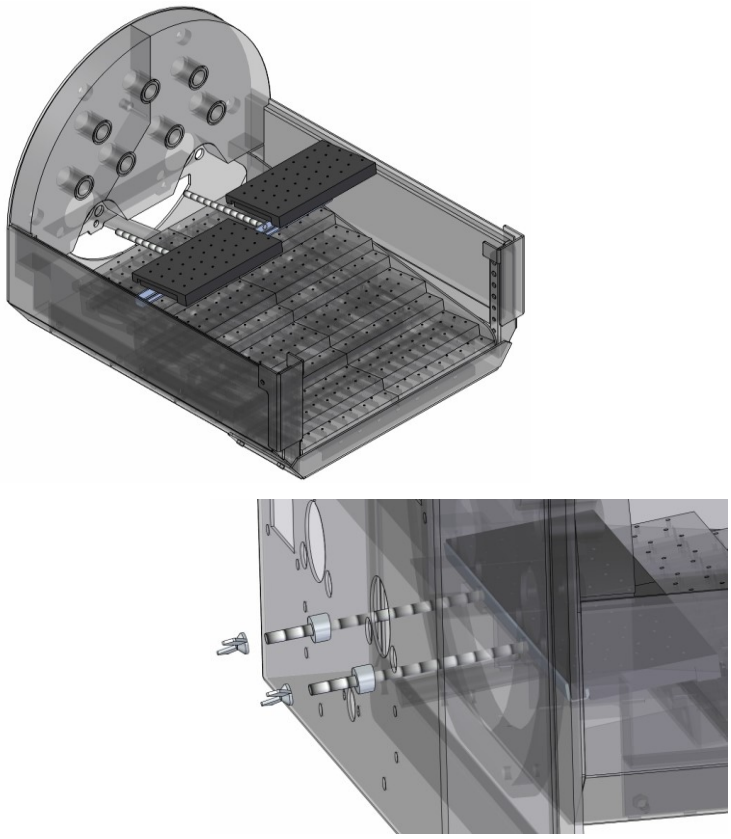


Figure 23

Install the upper grate holder and 2 upper grates. Fix the holder with M10 wing nuts.

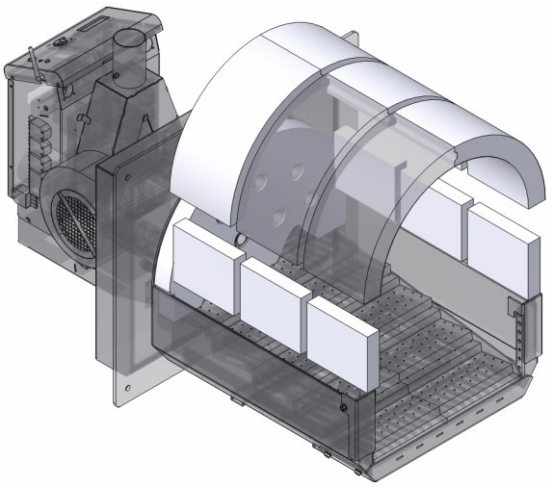


Figure 24

Install the 6 side bricks.

Install the 6 arc-stones.

Notice! The arc-stones are numbered; they must be installed as pairs!

2.3 Water sprinkler

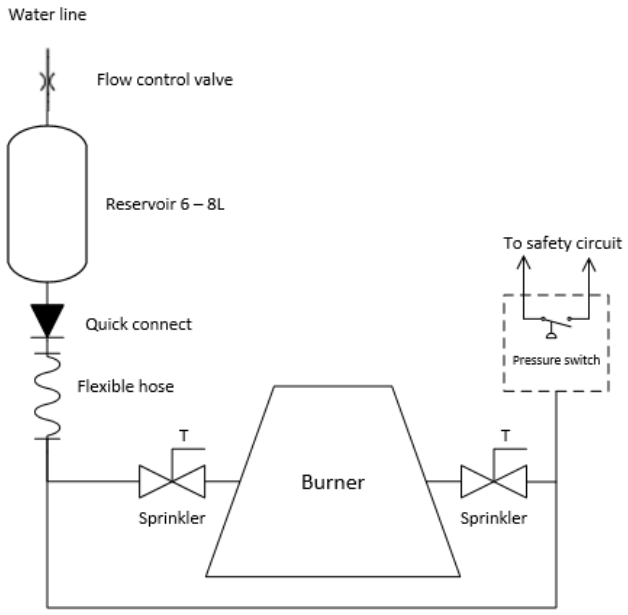


Figure 25 Water sprinkler installation

Principal chart of water sprinkler installation is depicted in Figure 25. Water sprinkler is main safety element against back-burning. It is strongly recommended to install sprinkler system. Pressure switch allows starting the burner only if water supply is present. If no water is available on installation site, reservoir can be filled manually. In this case, pressure switch is not connected to safety circuit as there is no pressure in water system.

In case of back-burning, sprinklers will open and fire is extinguished in feeder tubes. Flow control valve limits the amount of water flowing into burner after the reservoir is emptied. The burning chamber must be cleaned from wet ash and pellets before turning the burner back on again.

2.4 External auger

The external auger transports pellets from the pellet container to the burner. The burner controls the work of the external auger. The auger is connected to the burner with a special hose (Ø 76mm), which is made from easily melting material- polyurethane that acts as a safety measure against back-burning. PV1000a pellet burner´s fuel consumption at full power is about 208-222 kg of pellets per hour (3,3-3,7 kg per minute). External auger´s productivity for PV700/PC1000 must be at least 270kg of pellets per hour. The auger can be fixed to the storage or a ceiling depending on the conditions at the installation site.

Critical requirements for external auger installation:

- The raising angle of the auger must not exceed 45°
- The end of the exit tube of the auger and the input of the burner must not be aligned. The recommended minimal horizontal distance is ca 20cm.
- The distance between the input of the burner and the exit tube of the auger must be at least 60cm vertically – recommended distance is 80-200cm.
- Hose between auger and burner must be tight, otherwise pellets will block the auger. Falling angle must me between 65° and 85°.

All critical requirements for installation of external auger are depicted in Figure 26 .

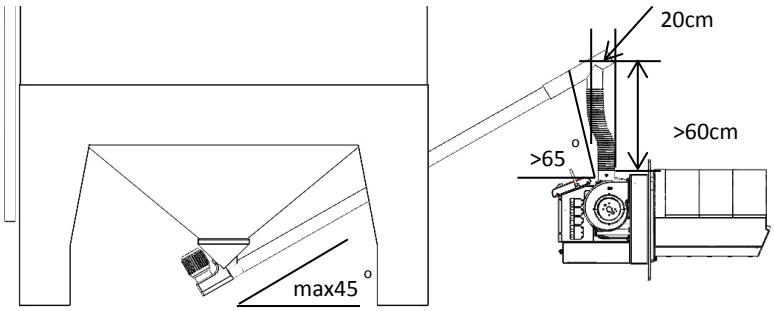


Figure 26 External auger installation

2.5 Pellet storage

Pellets must be stored in a dry and ventilated room that is separated from the boiler room. A tailor made storage (silo) is recommended. All safety regulation must be taken into consideration according to the local laws. It is recommended to wear a respirator when handling pellets. Refilling must be carried out before the storage runs empty.

2.6 Electrical connections

Following connections must be done by the electrical installer:

- 1-phase supply and boiler's thermostat to socket X11 . See Figure 27.
- 3-phase supply to socket X12
- External auger to socket X14

Names and marking of sockets is described on Table 4.

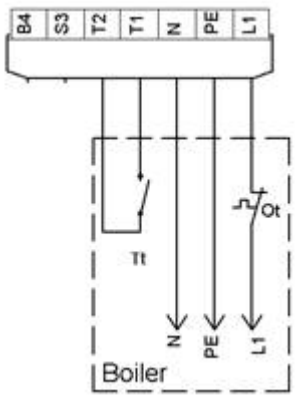


Figure 27 Connection of socket X11

Table 4 PV1000a connectors

No.	Name	Voltage, amps
X11	Control voltage, boiler's thermostat	230VAC, 3A
X12	Main power supply	3x380VAC 20A
X13	Safety circuit	230V
X14	External auger 1	3x380V 0,55kW 1,6A
X15	External auger 2	3x380V 0,55kW 1,6A
X16	Primary fan	3x230V 0,18kW/0,37kW (PV700/PV1000)
X17	Igniters	2x500W 2x2,2A (PV1000)
X21	Flue gas fan	3x230V max 1,5kW
X20	Flue gas inverter	0...10V, 24V DC
X22	Modbus	24V DC
X23	Pt100/4..20mA sensors (O_2 and boiler water)	24V DC
X24	Level sensors (silo1 and silo2)	24V DC
X25	Ash auger and scraper	230V 90W
X26	Secondary fan	3x230V 0,18kW/0,37kW (PV700/PV1000)
X27	Igniters	2x500W 2,2A (PV700, PV1000)

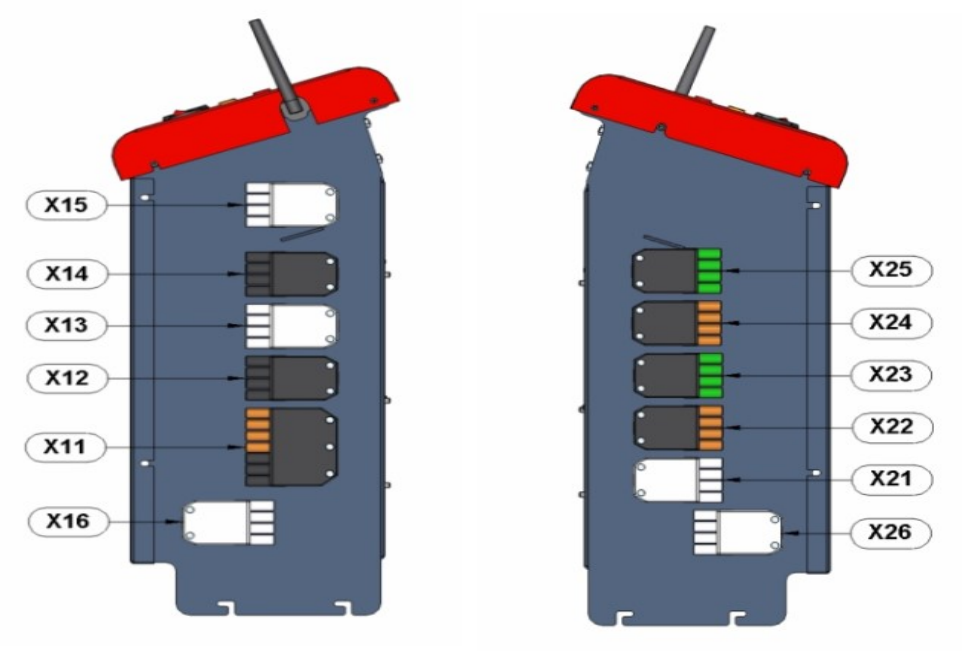


Figure 28 Connectors' markings

2.7 Initial start-up

Prior to the initial start-up of the burner make sure that:

- The burner is connected to the boiler.
- The boiler thermostat is installed and is functioning properly.
- The feeding auger of the burner is installed and connected to the burner.
- The smoke duct is connected to the chimney, the dampers for smoke gases are open and there is sufficient draught. When the burner is operating, the negative pressure inside the furnace must stay between 5-20 Pa.
- Sprinkler system is connected and pressure switch connected to safety circuit (chapter 2.3).
- Phase (L) and neutral (N) wires in power cable are connected properly.

3 Optional components

3.1 GSM modem

PV700a and PV1000a burners are ready to send burner's error SMS messages up to 5 phone numbers. When error occurs the modem will send list with history of errors and statuses before error. If list is very long then so much information what has a room in message will be sent. Average length of one message is 8 statuses or errors.

In order to send messages EP007 modem has to be connected to burners control board's connector X2. See Figure below. RS232 modem adapter cable has to be connected between modem's connector MOD1 and connector MOD1 what is located lower part of control board.

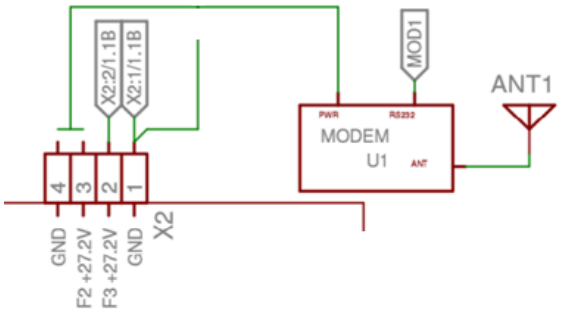


Figure 29 Modem connection

Before inserting the SIM card to burner the following actions have to be done:

1. SIM card must by activated by the mobile operator.
2. PIN code request has to be switched out.
3. Check by using mobile phone that it is possible to send SMS with this SIM card.
4. In SIM card´s phonebook must be only the numbers, where to the messages from the burner will be sent.

Figure 30 SIM card insertion

To insert the SIM card, the modem has to be disconnected from supply mains. To insert the card push it into a slot as long as its spring clicks and fixes the card. See Figure 30. To remove card push it in as long as spring clicks and pushes it out.
In order to activate SMS sending, in burners menu PAR52 has to be changed. Value shows for how many numbers the message will be sent. “0” means no messages to be sent. “2” means that messages will be sent to 2 first recipients in SIM card in order of phone number insertion.

Modem has two indicators. Green one shows that modem is turned on. Red one shows modem status. Modem’s statuses are described in Table 5.

Table 5 Modem statuses

Red LED indicator	Modem status
Permanently on	Sending message (on-going call)
Fast interrupt sequence (period 0,5 s Ton 1s)	Net search/Not registered/ Turning off
Slow interrupt sequence (period 0,3s Ton 3 sec)	Registered full service
Permanently off	Device is turned off

3.2 Error output

PV700/PV1000 burner has built in error output what gives 230 VAC tension (NO) to 7-pole socket’s S3 connector or interrupts it (NC) if burner delivers any error message from elven (FLAME ERROR, BATTERY EMPTY, IGN.ERROR etc). Device (motor, modem etc) up to 5A@230VAC can be connected to circuit. PAR50 defines weather error output is closed or open during error appearance. Depending on NO or NC selection values in PAR50 have to be changed.

PAR50 value	Description
1	Normaly open circuit (NO). Switches on when error appears.
2	Normaly closed circuit (NC). Switches off when error appears.
3	SWITCHED ON in IGNITING, HEAT UP, BURNING and HOLD FLAME statuses.
4	Not in use.
5	Not in use.

3.3 Flue gas fan

The burner needs stable under-pressure in burning chamber for its correct operation. Simplest way to assure this is to use the flue gas fan between boiler and chimney. With flue gas fan the burner can control and hold constant under-pressure. In order to control flue gas the PAR60 value has to be set to"2" ON. Selected flue gas fan must provide transmission of the maximum flue gas amount and exceed the pressure provided by boiler, ash cyclone and chimney. The flue gas capacity for burned pellets can be calculated by simplified formula.

$$V = \frac{P \cdot \lambda \cdot T_{fg}}{T_{room}}$$

V – Capacity range in m³/h
P – Burner max power in kW
T_{fg} – Flue gas absolute temperature in K
T_{room} - Room absolute temperature in K
λ (lambda) – Excess air ratio
PV burners are designed to work at lambda values 1.2...1,5 - for calculations choose value of 1,5.
Flue gas fan must be installed between boiler and chimney. If ash cyclone is used then flue gas fan must be installed between ash cyclone and chimney to avoid overpressure in cyclone and smoke leakage.

Burner setup

Depending on burner's configuration (weather inverter included or not) the electrical connections may be different. In case the frequency inverter has already been installed in factory to the burner, the flue gas fan can be directly connected to the burner through connector Y8. Fan must be connected to burner with 3-wire cable (3x1,5mm²). Internal inverter output is 3 x 230V. If flue gas fan motor is a three phase motor (3 x 230/380V) then it has to be connected as triangle.
In case the burner has no inverter, the external inverter for flue gas fan can be used.
Inverter must be selected according to fan motor's parameters and available power supply. The inverter must be switched to sink logic (negative common).
To connect the external inverter with burner there is connector Y7 with 3 output signals:

- T1 - burner DC common (ground), must be connected with external inverter input common.
- S3 – inverters "run" command, must be connected with F (forward) pin on inverter input. Burner will connect this pin to ground when fan must run.
- B4 – 0… 10V output for fan speed, must be connected with inverter analogue input.

Inverter setup

Inverter parameters are set up at factory for automatic control. To test flue gas fan manually:

1. Press Easy button on inverter
2. Press Dial button and change settings :
   CN0d – "0" FN0D – "0" F174 – "0"

3.4 Oxygen amount sensor

Oxygen amount sensor (oxygen sensor) allows the burner to keep pre-set oxygen level in flue gas, what increases the efficiency of the burning process. The oxygen sensor is connected to socket X23 as shown on

Figure 31 .

If the sensor requires heater connection, it can be connected between T6 and B5.

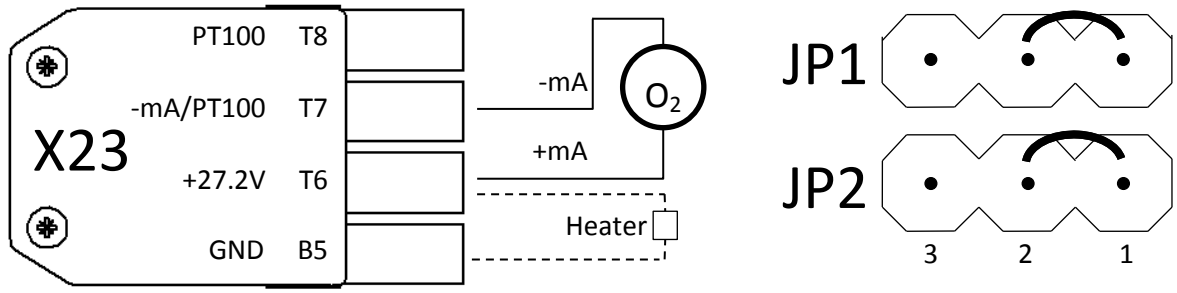


Figure 31 Oxygen sensor connector

Following instruction is applicable for firmware version 2.08.
In order to implement oxygen sensor two parameters PAR66 and PAR67 in parameters menu have to be set-up:

Table 6 PAR66 and PAR67 set-up

Parameter		Description	Unit	Value		
No	Name			Def	Min	Max
PAR66	OXYGEN TYPE	0 – no sensor 1 – 4…20mA = 0…25% oxygen 2 – 4…20mA = 0…20% oxygen	-	0	0	2
PAR67	OXYGEN SET	Oxygen level set-point in flue gas	-	6	4	12

For oxygen amount sensor EP0006 in parameters menu, the PAR66 value has to be set to “1”. Some third party oxygen amount sensors use 4…20mA output for 0…20% oxygen. In this case, value “2” must be selected.
If PAR66 is set to “0” (no sensor), secondary fan is driven by air table set in PAR31 – PAR36. Secondary fan also switches back to air table if oxygen level reading is below 3% or over 19%. Oxygen sensor is located inside the burning chamber. Oxygen level control starts 5min after burner enters into BURNING status. It can take about 10min for oxygen level to stabilize.
Oxygen level can be seen in INFO-menu next to pressure reading. The value on the screen must be divided by 10 to get the real value. For example “O2=113” means oxygen level value 11.3%.

3.5 Ash removal system

The burner can control external ash removal auger and scraper motors via X25 connector. During burner's cleaning cycle the X25 connector is powered and ash removal and scraper motors can be switched on via X25 connector's L1 and L2.

3.6 External boiler temperature sensor

External temperature sensor enables the burner to maintain constant boiler's water temperature. For that external temperature sensor has to be installed to relevant place on boiler, existing burner's temperature sensor to be disconnected from TMP1 connector on controller's board and external sensor to be connected to connector TMP1. In parameters menu PAR53 value has to be chosen "2".
When temperature holding status is activated, then burner will change its capacity according to water temperature and speed of temperature changing. Burner starts to change its capacity when BURNING status has lasted longer than set in PAR15. Capacity is changed after time set in PAR17.
Following actions must be done to enable temperature hold mode (THM):

1. Mount external temperature sensor to boiler according to boiler manufacturer instructions.
2. Connect the sensor to TMP1 connector on controller board.
3. Choose PAR53 value (sensor type) according to Table 7.
4. Set requested temperature – PAR54. It should be lower than boiler thermostat temperature.

Otherwise the boiler thermostat would force the burner to turn off before reaching PAR54 value.

5. Optionally PAR55 - the hysteresis of requested temperature can be changed.

THM activates if PAR53 value is larger than "1" and BURNING status has lasted longer than set in PAR15 typically 30min). The burner will change its output power according to current measured temperature and the rate of temperature change. New power level is selected after every time interval specified in PAR17.

Table 7 PAR53 values

PAR53	Sensor type	Temp min	Temp max	Function
0	No sensor	-	-	-
1	0..2.5V	0ºC (0.5V)	125ºC (1.75V)	Burner's actual internal over temperature sensor. Overheat value to be set PAR43.
2	0..2.5V	0ºC (0.5V)	125ºC (1.75V)	Boiler temperature control with external sensor.

After activating THM, following row is displayed on INFO-screen e.g.: „T=22.3/70±5↓200^{o}". It means following:
22.3 – Actual measured temperature.
70 – Set point temperature (PAR54).
±5 – Set- point hysteresis (PAR55).
↓ - Shows weather actual temperature is increasing or decreasing.
200^{o} – Forecasted temperature in 10min.

4 Operation and service

4.1 User interface

The burner is controlled via user interface on the front panel. 3 row LCD screen (1) displays main menu, submenus, event log and statuses. Yellow light (2) shows the existence of flame in burning chamber. If it blinks, the burner is out of normal operation. Green light (3) indicates existence of pellets in the burner. Burner on/off switch (4) can be used any time to turn the burner safely on or off. Operation light (5) indicates weather the boiler thermostat is turned on or off. Fault light (6) is connected to safety circle and indicates its being in order.

"Up" and "down" (**Λ V)** buttons enable to move in menus.

"Left" and "right" (**> <**) buttons enable to control the burner and change parameters. To get back to main menu (**<)** button is used. It acts like an escape button. "Right" (**>**) button enables to change values in selected parameter. To enter to setup menu or to confirm changes of values OK button is used. OK and **<** buttons have different functions depending on context. See Table 8.

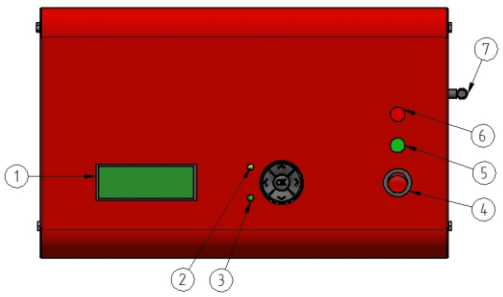


Figure 32 User interface

1 – 4x20 character display
2 – Yellow LED, indicates if flame is detected in burning chamber
3 – Green LED, indicates if pellets are present in internal feeder
4 – Burner on/off switch with power indication light.
5 – Burner operation light, showing if the boiler thermostat sends a signal to the burner.
6 – Fault light of safety circle
7 - GSM modem antenna

Table 8 User interface controls

Button	Push time	Action
OK	<3s	To enter to setup menu To confirm settings (in parameter edit mode)
OK	>3s	To reset error, resume normal operation To reset counter (only in counter screen in INFO menu)
<		To move back in menu by one level

		To cancel change (in parameter edit mode)
OK + <	>3s	To restart burner

4.2 Starting and stopping

To turn on the burner:

- Turn on boiler main switch.
- If burner displays STOPPED, then go to main menu and BURNER set from ON to OFF. WAITING is displayed.
- Turn boiler's thermostat to requested temperature.
- Burner goes to TESTING state and then to LOADING state. If this is the first run, external auger needs to fill up with pellets. It can take as long as 20minutes, because external auger has to be filled with pellets.

To stop the burner:

- set in main menu BURNER from ON to OFF. Now the burner will burn all pellets in burning chamber and turn safely to STOPPED mode.

STATUS menu displays the changes:
BURNING → SLOW DOWN→ END BURN →END BLOW→ WAITING → STOPPED
The stopping procedure may take up to 30 minutes.
Attention! If necessary the boiler's thermostat can be turned on/off from burner red switch with power indication light Figure 32.
Caution! Do not turn off mains power to terminate burning process. Use the boilers thermostat for that. In order to complete burning procedure safely let the burner to burn all fuel in burning chamber. Never leave burner unattended when you had to stop boilers work turning boiler off from mains switch in any reason.

4.3 Fuel refilling

Fuel container (silo) has to be refilled before its runs out. The fuel can be added any time to container (silo). If container runs out before refilling, refill it and restart the burner. The start-up takes now longer about 20 minutes, because external auger has to be filled with pellets like in initial start-up. Turn burner from BURNER menu ON. Vice versa the LEVEL ERROR will be displayed, because loading time is exceeded.

4.4 Statuses and parameters

PV700a/PV1000a pellet burner operates in many different states, which are called "Statuses" and which are displayed in user interface in STATUS menu (chapter 4.1). Burner changes its statuses based on input signals from sensors and user setup. The working statuses of the burner in typical order of succession are given in Table 9.
The duration of all actions are in form mm:ss ('m' in the middle) or hh:mm ('h' in the middle). For example: 'IGNITING 01m25"means the burner ignition state lasted 1 minute and 25 second.

Table 9 Summary of burner statuses

Status	Short description
WAITING	Waiting when boiler's thermostat switches on.
TESTING	Boiler's thermostat is switched on, testing the battery, fans, feeder, level sensors and draught in progress.
CLEANING	Ash removing from burning chamber.
LOADING	Loading pellets with external auger into burner and by feeder auger into burning chamber.
IGNITING	Igniter is turned on, pellets are ignited.
PRE-BURN	Flame is recognized, small amount of pellets is added by feeder auger.
HEAT UP	Burning chamber ceramic stones are heated up.
BURNING	Normal burning operation.
HOLD FLAME	Thermostat is switched off, small flame is held alive.
END BURN	Thermostat is switched off, feeder is burned up.
END BLOW	Pellet coals in burning chamber are burnt, flame has disappeared.
WAITING	Burner waits when boiler's thermostat switches on.

At **WAITING** status, the burner waits when boiler's thermostat switches. There is no time limit for WAITING status. Only feeder auger is working periodically at WAITING status and makes ½ rotations after every 2 minutes. With this feeder augers spiral cleans feeder's tube from wastes.
When boilers thermostat switches on, burner will go to TESTING.
At **TESTING** status, burner's integrity and important device functioning are checked. List of tests is given in Table 10.

Table 10 List of tests in TESTING status

Test name	PAR No	Value	Unit	Test conditions
Battery voltage	-	22	V	Battery loading is turned OFF and feeder is turned ON - voltage must be greater than 24V.
Feeder current	PAR 46	3..6	A	Feeder auger is turned ON – feeder current must be smaller than PAR 46.
Draught	PAR62	+10	Pa	All fans are turned on. Draft must be under PAR 62.
Primary fan	PAR4	38	rot	Fan must rotate faster than 35rot = 38 (PAR4) – 3.
Secondary fan	PAR4	38	rot	Fan must rotate faster than 35rot = 38 (PAR4) – 3.

At **CLEANING** cycle, the linear actuator moves the grates and pushes out from burning chamber the ash and residues. The cleaning cycle has been divided into 3 steps:

1. Grates are pulled fully in to actuator end limit.
2. Grates are pushed fully out to actuator end limit.
3. Grates are moved to middle position.

Table 11 CLEANING parameters

PAR name	PAR No	Value	Unit	Test conditions
CLEANING CYCLE	PAR48	0...250	min	BURNING time between two CLEANING cycles. If set to 0 then CLEANING is turned off. If BURNING has been longer than 2x PAR48 set, then extraordinary cleaning will made.
GRATES CURRENT	PAR47	0.2..6	A	Linear motors maximum current level. If greater, then motor is stopped and cleaning cycle is started again.
Linear motor's min. current	-	0.1	A	If current is smaller, then motor is stopped and running direction can be changed.
Max. move time	-	58	sec	Maximum time to move actuator to one direction.
Max. cleaning time	-	100	sec	Maximum CLEANING cycle time.

At the **LOADING** cycle, external auger is turned on. When pellet level in the burner reaches to level sensors, internal feeder is started. Feeder auger loads necessary amount of fuel needed for ignition into burning chamber. Amount of loaded fuel is measured by counting the rotations of feeder auger. LOADING cycle is ended when feeder auger has made exact number of rotations pre-set in PAR24.

Table 12 Loading parameters

PAR No	Parameter name	Default value	Unit	Comment
PAR24	LOADING FEED	35..40	rot	Number of feeder auger rotations needed to load pellets into burning chamber. Depends from burner model.
PAR25	LOADING 2 FEED	5	rot	Number of feeder auger rotations for second loading.
-	Max loading time	5	min	Maximum regular loading time
-	First loading time after manual start	20	min	Maximum loading time after manual start.
-	External auger start	3	sec	Auger Start delay if no fuel in burner
-	External auger stop	3	sec	Auger Stop delay if fuel in burner
-	Feeder auger start	1	sec	Feeder Start delay if fuel in burner
-	Feeder auger stop	4	rot	Feeder rotations made without fuel level before stopped.

At the **LOADING** time, external auger holds permanent fuel level in the feeder auger's tube. Depending on the level sensor signal, the external auger is turned on or off.
Feeder auger's work depends also on fuel level sensor signal.
Maximum loading time is limited by 20 minutes after manual (initial) start up because extra time for external auger filling is needed. In next loadings, maximum time is limited by 5 minutes.
If maximum loading time is exceeded and silo selection on burner is used, the pellet delivery will be switched to other external auger. In single pellet container delivery system NO PELLETS error will occur.

At **IGNITING** cycle the igniter is heated up and fan blows hot air on pellets in burning chamber. Hot air ignites pellets. Igniter is working periodically at ignition time in order to avoid its overheating.
Igniter is pre-heated already in the end of loading cycle. When internal auger has made 10 rotations (full number of load rotations is 12) the igniter is turned on for pre-heating. If the igniter has been turned on more than 1 minute at LOADING time, then it will be turned off.

Table 13 IGNITING parameters and timing

PAR No	Parameter name	Default value	Unit	Comment
PAR8	FAN @IGNITING	25	rps	Primary fan speed at ignition.
-	Max ignition time	255	sec	Maximum ignition time.
-	Time of first loading	20	min	Maximum loading time after manual start.
-	Auger start	3	sec	Auger Start delay if no fuel in burner.
-	Auger stop	3	sec	Auger Stop delay if fuel in burner.
-	Feeder start	1	sec	Feeder Start delay if fuel in burner.
-	Feeder stop	4	rot	Feeder rotations made without fuel level before stopped.

The purpose of **PRE-BURN** status is to create stabile flame and assure effective pellets burning procedure after ignition. Minimum fuel amount is added periodically at pre-burn time. Fans are working with same speed as at IGNITION. Feeder auger makes ½ rotations at every 25 sec up to 6 rotations achieved. See Table 14.

Table 14 PRE-BURN parameters

PAR No	Parameter name	Default value	Unit	Comment
PAR8	FAN@IGNITING	20	rps	Primary fan speed at IGNITING and PRE-BURN
PAR39	FAN 2 MIN	7	rps	Secondary fan's minimum speed. Used at IGNITING, PRE-BURN, HEAT UP, HOLD FLAME and END BLOW statuses.
PAR41	PRE-BURN TIME	25	s	Length of one PRE-BURN cycle.
PAR42	PRE-BURN CYCLES	6	x	Number of PRE-BURN cycles.
-	Pre-burn feed	1/2	rot	Number of feeder auger's rotations at each PRE-BURN cycle.

HEAT UP cycle is needed to slow down too fast heating up of the burning chamber's ceramic stones in order to minimize their thermal stress and thus prolong their lifetime.

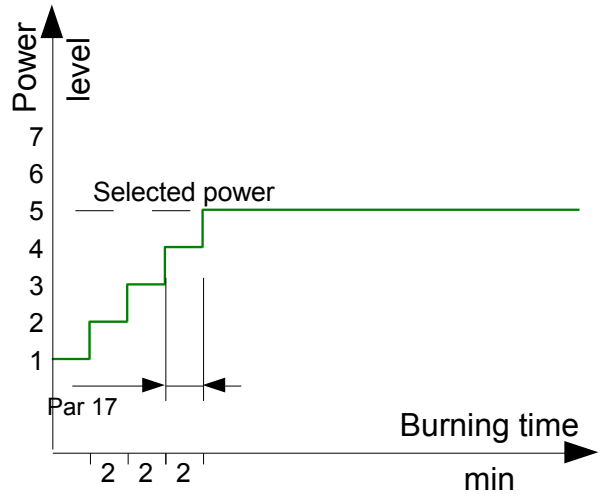
Table 15 HEAT-UP parameters

PAR No	Parameter name	Default value	Unit	Comment
PAR70	HEAT UP TIME	20	min	Initial heat up time of ceramic stones.
PAR71	HEAT UP POWER	30...70	kW	Initial heat up power of ceramic stones.
PAR72	HEAT UP TEMPERATURE	500	°C	Ceramic stone minimum temperature.

When HEAT UP is in mode ON - burner stops HEAT UP cycle after heat up time set in PAR70 is exceeded. (Temperature of stones is not measured directly).
When HEAT UP is in AUTO mode - burner stops HEAT UP cycle after time set in PAR70 is exceeded or stone temperature is higher than set in PAR72. (Temperature of stones is not measured directly).
BURNING is main action status in burner's every day's operation.
Burner can operate on 11 different fixed power levels. There are 6 main power levels, which can be selected and adjusted. 5 virtual power levels (between main power levels) are for smoother operation – they can't be adjusted or selected.
For every power level, the primary fan speed is fixed in PAR1...PAR6 and secondary fan speed in PAR31...PAR36. The fan speed for virtual levels is calculated as average from previous and next main level speed. Power levels are represented in Table 16.

Table 16 Power levels

Power level	Level type	PV700	PV1000	Primary fan	Secondary fan
1	**main**	**200**	**250**	**PAR 1**	**PAR 31**
2	virtual	250	320	-	-
3	**main**	**300**	**400**	**PAR 2**	**PAR 32**
4	virtual	350	470	-	-
5	**main**	**400**	**550**	**PAR 3**	**PAR 33**
6	virtual	450	620	-	-
7	**main**	**500**	**700**	**PAR 4**	**PAR 34**
8	virtual	550	770	-	-
9	**main**	**600**	**850**	**PAR 5**	**PAR 35**
10	virtual	650	920	-	-
11	**main**	**700**	**1000**	**PAR 6**	**PAR 36**



Power level can be selected in main menu. Power level selection for burning time can be automatic or fixed on some main level. When power level is fixed, the power is slowly raised to selected level and will be there until boiler thermostat switches off.

Figure 33 BURNING at fixed power

In Automatic Power mode (POWER set to AUTO in main menu), the operation power is selected automatically depending of burning cycle length.

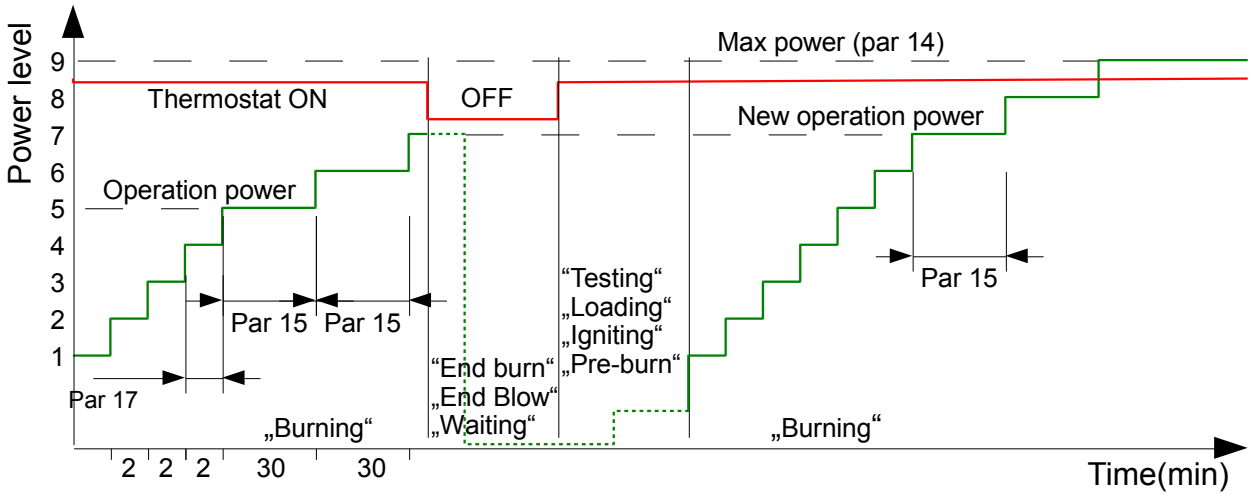


Figure 34 Burning procedure when power selection = AUTO

In **SLOW DOWN** mode, the burner power is reduced step-by-step to 1 level after boiler thermostat is switched OFF. This mode can be used only in systems with high and stable power demand. Using "Slow down" mode in systems with low thermal inertia or unstable power demand, there will be risk of system overheating. The SLOW DOWN mode is recommended to use together with HOLD FLAME.

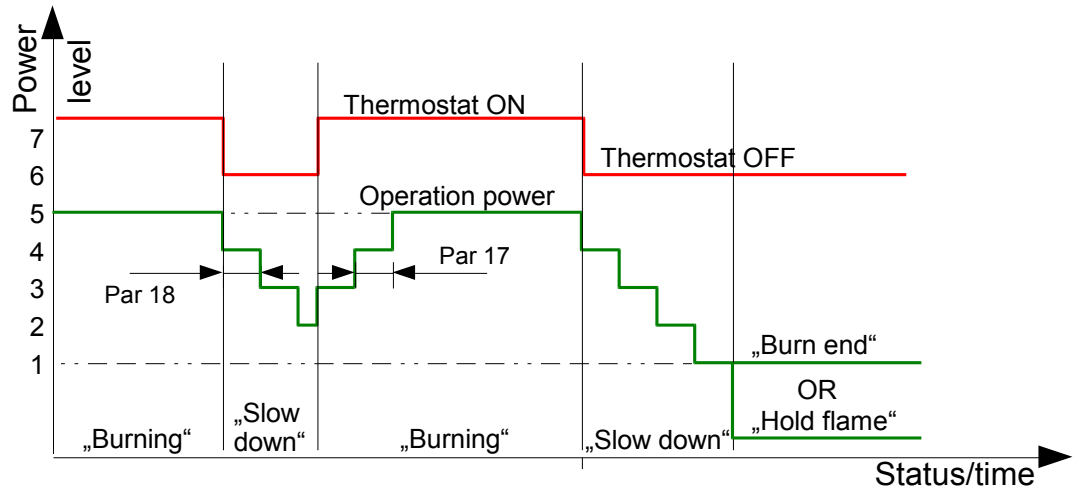


Figure 35 SLOW DOWN mode

The purpose of **HOLD FLAME** mode is to avoid burner start-up procedures i.e TESTING, CLEANING, LOADING, IGNITING etc. every time, when burner is switched on from boiler thermostat. In HOLD FLAME mode, minimum fuel and air amount are delivered to burning chamber. HOLD FLAME mode can be switched on from burner main menu. When HOLD FLAME is set to AUTO, burner will turn the mode ON or OFF depending on WAITING time:

- If WAITING (time between END BLOW and boiler thermostat switched on) is shorter than set in PAR 11, then HOLD FLAME mode will be switched on.
- If HOLD FLAME time is longer than set in PAR12, HOLD FLAME mode is switched off.

HOLD FLAME is also used as intermediate state before CLEANING or after SLOW DOWN.

Table 17 HOLD FLAME parameters

PAR No	Parameter name	Default value	Unit	Comment
PAR10	FAN@HOLD FLAME	10	rps	Primary fan speed at HOLD FLAME
PAR39	FAN 2 MIN	7	rps	Minimum speed of secondary fan. Used at IGNITION, PREBURN, HEAT UP, HOLD FLAME and END BLOW statuses.
PAR11	HOLD FLAME ON	15	min	If two consecutive WAITING states have been shorter than 15 min, HOLD FLAME will be activated.
PAR12	HOLD FLAME OFF	60	min	Maximum time when burner holds flame.

The **END BURN** cycle helps securely to stop burning procedure in burning chamber of burner. All pellets inside the burning chamber and feeder tubes will be burnt. Amounts of pellets delivered and fan rotation speed (power level) are same as in BURNING status. If burner goes to END BURN from other states (e. g. HOLD FLAME), the first power level is selected. Burner works in END BURN until feeder tube is empty - feeder has made as many rotations as selected in PAR26. END BURN can be used in case of some

occurred errors e.g. If pellets have run out and NO PELLETS is displayed the burner stops safely normal BURNING cycle.

Table 18 End burn parameters

PAR No	Parameter name	Default value	Unit	Comment
PAR26	END BURN FEED	50..80	rot	Feeder auger rotations to clean up feeder's pipe.
-	Minimum feed	20	rot	If less rotation are made and boiler thermostat is switched on then burner goes back to BURNING state.

The **END BLOW** cycle is needed to burn finally all unburned pellet coals in the burning chamber. Burner will wait for flame disappearing in burning chamber. In PAR27 is fixed the end blow time, i.e. the time how long the fans continue to blow after flame's disappearing.

Table 19 END BLOW parameters

PAR No	Parameter name	Default value	Unit	Comment
PAR9	FAN@END BURN	20	rps	Fan speed at END BURN.
PAR39	FAN 2 MIN	7	rps	Minimum speed of secondary fan. Used at IGNITION, PREBURN, HEAT UP, HOLD FLAME and END BLOW statuses.
PAR27	END BLOW TIME	2	min	Time to blow air after flame is disappeared
-	Max. END BLOW time	15	min	Maximum time when flame must disappear at END BLOW.

4.5 Output power levels

Burner has 6 pre-set output power levels. For every level, the program calculates correct fuel amount what depends on fuel's calorific value and burner's internal feeder productivity. The feeder productivity for normal, light and heavy pellets can be changed from main menu. For normal pellets it is 160 grams per rotation (PAR21). Calculated amount of fuel is divided into periodic feeding cycles. In every normal cycle internal feeder makes half rotation. If the calculated time of cycle comes too short then the cycle length will doubled and fuel will loaded with full rotation of feeder. For every power level there is different pre-set fan rotation speed (PAR1..PAR6).
Burner chooses the output level between pre-set min and max powers. When burning time has been more than 15 minutes (PAR15), next time burner takes one power level up, when burning time has been less than 30 minutes (PAR16), next time burner takes one power level down.

4.6 Main menu and settings

To enter to set up menu press OK. To go back to main menu, press **<** button.

Table 20 Main menu

Menu nr	Menu para-meter ENG	Description	Default settings	Options
1	STATUS->	Submenu with status		
2	INFO->	Burner's info		
3	BURNER	Burner's turning	OFF	ON/OFF
4	HOLD FLAME	Hold flame allowed	OFF	ON/OFF/AUTO
5	HEAT UP	Slow heat up	AUTO	AUTO/ON/OFF
6	SLOW DOWN	Slow cool down	OFF	ON/OFF
5	PELLETS	Fuel quality options	NORM	NORM/LIGHT/HEAVY
7	POWER	Power level selection	AUTO	PV700: AUTO/200/300/400/500/600/700 PV1000: AUTO/250/400/550/700/850/1000
8	BASE AIR	Fan speed change at once for all power levels	0	-2/-1/0/+1/+2/+3/+4/+5
9	SILO	Container selection	1	1 2 3 4
10	LANGUAGE	Language options	ENG	*Annex 5 List of languages*
11	PARAMETERS -	Parameters menu		*Annex 4 List of parameters*

STATUS info screen displays last events (burner states) and their duration. The duration is in form mm:ss ('m' in the middle) or hh:mm ('h' in the middle). For example "Igniting 01m25 means the burner ignition state lasted 1minute and 25 seconds. Last row of the log shows current state. To reach the last row, press the "down" button, until you reach the current state. The duration of current state updates every second or minute.
INFO menu is useful to troubleshoot various problems. It gives access to some input signals and internal parameters. Use up and down arrows to scroll through info menu.

Note: Comma "," is used as decimal separator.

Table 21 Info menu description

Screen text	Description
Pwr 150/700 kW	actual and selected power. Max power can be changed from main menu.
Tstn=181^{0}C T1=205,7^{0}C	Tstn – fire brick temperature and boiler's temperature.
Fan=27/28±2 12/13	27 – Primary fan's actual speed. 28 – Primary fan's set-point speed. Actual speed is controlled to match set-point speed. ±2 - Base air value. Controller tries to keep speed set-point + base air. In this case controller keeps speed 15rps. Speed unit is rps (rotations per second). 12/13 – same as above for secondary fan. Base air setting is same ±2.

Δp=-0,2/-8Pa	Measured under pressure value in bpoler. -0,2 is actual pressure and -8 is set-point. Controller regulates flue gas fan speed to keep this pressure. Depends also on PAR60 value.
Total=10 kg	Roughly the amount of pellets burnt. It is measured by counting internal feeder rotations. Number is reset by firmware upgrade
Count=12,1 kg 180/254	Roughly the amount of pellets burnt, resettable by user.
U=25V68 I=0.0A	U - DC power voltage 25V68 means 25.68V. I – Feeder's or grate's motor current.
Ver=2.08 19/12/12	Firmware version and date.

Menu **BURNER** enables to turn burner safely ON or OFF.

The main idea of **HOLD FLAME** function is to reduce permanent ON OFF cycles. This function is useful if burner's working time is much longer than WAITING time. For example 1 hour of working time and 10 minutes of waiting time. In „HOLD FLAME"status the fan rotates slowly (PAR10) and small quantities of fuel are added to burner. Existence of flame is not checked. Such status may last max one hour, after what burner ends usual BURNING cycle and goes to WAITING. If boiler's thermostat switches on before an hour, burner goes to BURNING state. HOLD FLAME is activated when it is set to AUTO and two WAITING times have been shorter than set value in PAR11. HOLD FLAME turns off if flame has been hold more than PAR12 value.

HEAT UP status enables slow heat up of fire bricks. It reduces termal stress and prolongs their lifetime.

SLOW DOWN enables slow cooling down of fire bricks. It reduces termal stress and prolongs their lifetime.

Menu **PELLETS** enables to select between 3 pre-set fuel quality options. Depending on fuel quality the mass of fuel could differ in same amount. That's why the calorific value of same amount may differ. By default burner calculates that one rotation pushes 80 grams pellets (PAR21) to burning chamber. If pellets density is smaller i.e. they are lighter, then with one rotation less pellets will be delivered into burning chamber. Such mistake has to be compensated by choosing LIGHT from PELLETS menu. Now burner calculates that one rotation equals with 75 grams of pellets (PAR31) and makes more rotations. In general case there is no need to make change in PELLETS menu.

Menu **POWER** determines caloric productivity of burner in kilowatts. Power is calculated by reading the rotations of the feeder auger, taking into account average caloric value of 1 kg of pellets. It is possible to pre-set particular (200; 300; or else) power level value or AUTO - automatically selected value. In AUTO status burner selects necessary power level depending on time what is needed to achieve pre-set temperature. Burner changes its capacity what is determined by parameters MIN POWER (PAR13) and MAX POWER (PAR14). If burner cannot achieve pre-set temperature in certain time (PAR15) it will raise its power automatically by one level and continues rising power up to reaching maximum level (PAR14) or boiler has achieved pre-set temperature.

If boiler achieves pre-set temperature faster than set in PAR16 burner will work one power level lower in next cycle. Power will be reduced as long as burner has reached minimal power level (PAR13).

Menu **BASE AIR** increases or decreases speed of fan in all power levels by same number. It is reasonable to use base air to balance different characters of particular heating systems. For example if draught is very strong, the fan can work at lower speed and thus reduce the draught.

SILO menu enables to burner to choose between four pellet containers.

Menu **LANGUAGE** enables user to select between 17 languages. Table of languages is in Annex 5.

Menu **PARAMETER** gives overview of burner's default and minimum- maximum settings. The menu enables fine tuning of the burner what in general is not necessary. Short description of burner's parameters is given in Annex 4.

4.7 Regular maintenance

Pellet burner requires systematic maintenance**.** The maintenance period depends on the quality of the pellets and heating intensity. The boiler must be cleaned weekly. For more information about cleaning the boiler, please see boiler's user manual.

The burner should be cleaned at least two times in a heating season.To clean the burner:

1. Turn off the burner by turning the boiler's thermostat to 0.
2. Let the burner cool down for at least 1 hour.
3. Open the boiler's door to gain access to the burning chamber.
4. Remove the grates and clean them from any residues. Before removing is recommendable to mark grates. Make sure that all holes on the grates are clean.
5. Remove the bottom panel to gain access under the grate movers to clean the ash from the burning camber.
6. Reattach the bottom panel.
7. Place back the grates taking into account their marking. Ensure that grates fit to holders.
8. Close the boiler's door to finish the maintenance and turn the thermostat to desired temperature.

The connection between the boiler and chimney must be completely airtight. There mustn't be any extra draught in the smoke draft of the boiler. All cleaning and maintenance openings must be closed with covers.

5 Problems and solutions

Message on screen	Reason and solution
BATTERY LOW	• Battery voltage is less than 24V with load (working feeder motor). ○When there was blackout then just wait when battery recharges itself. ○Replace battery.
IGN.ERROR	• No flame detected at ignition time. ○Igniter is out of order or fuse is blown. Usually fuse blows when igniter is broken or its body is in short circuit. Replace fuse or igniter ○Flame sensor is dirty or smelt. Clean or replace sensor if needed.

	○Amount of pellets for igniting is too small. If error is frequent, increase amount of pellets PAR24.
STOPPED	• Burner is turned OFF from main menu. ○To turn burner on hold OK button down 3 seconds or change in BURNER menu OFF to ON.
LEVEL ERROR	• Feeder auger doesn't rotate. ○Remove plastic hose and check is there any foreign object or very long pellet jammed the feeder auger. Remove obstacle. • Level sensor is dirty or smelt. Clean or replace sensor if needed. • Poor draught, dirty sensor. Check sensor, clean if needed. Improve draught.
NO PELLETS	• Max loading time is reached, but level sensor hasn't detected enough fuel in feeder or in burning state during 4 minutes no pellets detected. ○No pellets in container. Check existence of pellets, refill container. ○External auger is broken. Check fuse and connection with burner. Replace fuse or auger. ○Fuel level sensor is broken or short. In this case transparent tube has to be filled with pellets. Replace sensor. ○Too much sawdust in container and external auger can't reach the pellets. Remove sawdust.
NO FLAME	• Flame is disappeared at pre-burning time or at burning time. ○Fuel level sensor is dirty or broken. Check sensor, clean or replace if needed. ○Flame sensor is dirty or smelt. Clean or replace sensor.
SRP	• Appears in screen for some seconds when turning on the burner. ○If message doesn't disappear push any button on the front panel.
FEEDER ERROR	• Feeder auger has not made any rotations in 8 seconds at its running time. ○Feeder auger motor's rotation sensor is too far from magnet. Check sensor's placement. It has to be located maximally on magnet and not far than 2..3 mm. Sensor has not to touch rotating parts of motor. ○Feeder motor's reducer may be broken (if motor makes noise). Replace both. • Feeder auger motor current has reached its limit and over-current protection applied. ○Feeder auger may be blocked or jammed by foreign object. Remove obstacle.
FAN ERROR	• Fan has not reached enough speed at testing time. Fan motor's rotation sensor is too far from magnet. Check sensor's placement. It has to be located maximally on magnet and not far than 2..3 mm. Sensor has not to touch rotating parts of motor. ○Fan doesn't rotate. Bearings too dusty or fuse blown. Clean bearings or replace fan. ○Fuse has blown. Replace fuse.
NO POWER	• The mains supply doesn't reach controller. ○Back burning and safety thermostat have turned mains off. Possible reasons are poor draught, too much ash in burner or in boiler or poor burning procedure. Improve draught, remove ash, use only quality pellets. Poor burning may be caused by big amount pellets feed (heavy pellets) or poor stream of the air. Change PAR23 "heavier". ○General blackout. Wait for end. Restart burner.
OVERHEAT	• Burner internal temperature reached over set-point as fixed in setup menu. • Possibly back-burning is happened. ○Bad connection of temperature sensor. Check and improve if needed. ○Insufficient entrance of fresh air into the boiler room. Draught to wrong direction. Ensure

	availability of fresh air and improve draught.
GRATE ERROR	Over- current of grate movers motor has exceeded value set in PAR47 and over- current protection has applied. ○ Ash removing grate has jammed before reaching extreme point. Remove reason. • Motors power screw got dirty and stops rotation. Clean the screw.
Screen empty, backlights on	• Controller error or screen error. o Replace respective component. • The contrast of screen is poor. Contrast can be adjusted with small screwdriver by turning the resistor CONTR on down edge of controller. In one extreme the screen displays nothing and in other extreme screen is filled with black rectangles.
Screen empty no backlights	• No mains supply.

6 Burner status change logic

Table 22 Error messages in screen

Status	Next Status	Change conditions
WAITING	TESTING	Boiler's thermostat switches on.
TESTING	CLEANING	All tests are passed successfully
	BATTERY ERROR	Battery voltage is less than 24V in burdened status.
	FAN ERROR	Fan does not reach 40 rps at PRE-BURN.
	LEVEL ERROR	The level sensor recognizes pellets in the feeder.
CLEANING	LOADING	The grates are moved and ash is removed from burning chamber.
	GRATE ERROR	Grates are not moving as expected.
LOADING	IGNITING	Feeder makes loading rotations 40 rot/min (PAR24).
	NO PELLETS	Maximum loading time (5 min normal or 20 min initial) is reached.
	END BURN	Flame detected and unknown start conditions. LOADING restarts.
LOADING 2	IGNITING	Previous state was ignition and feeder made 3 rotations.
	PRE-BURN	Previous state was hold flame and feeder made 3 rotations.
IGNITING	PRE-BURN	Flame recognized.
	LOADING 2	Max ignition time (255* sec) is reached and load 2 is not done.
	IGN. ERROR	Max ignition time 255 sec is reached and load 2 is done.

PRE-BURN	BURNING	3 pre-burn cycles each 40 sec are done and continuous flame is recognized more than 10 seconds.
	LOADING 2	Pre-burn cycles are done and flame is NOT recognized and load 2 is NOT done.
	NO FLAME	Pre-burn cycles are done and flame is NOT recognized and load 2 is done.
BURNING	END BURN	Boiler's thermostat is NOT switched on. (HOLD FLAME is NOT allowed).
	HOLD FLAME	Boiler's thermostat is NOT switched on. (HOLD FLAME is in AUTO mode).
	END BURN	Maximum continuous burning time (4 hours) is reached.
	BURN END -> END BLOW - >LEVEL ERROR	Fuel level is continuously detected in time of 8 feeder auger rotations.
	BURN END -> END BLOW - >NO PELLETS	Fuel level is not detected in 4 min.
	NO FLAME	No Flame more than 2 minutes
HOLD FLAME	LOADING 2	Boiler thermostat is switched on.
	END BURN	Max KEEP FLAME time (1 hour) is reached
END BURN	END BLOW	Flame is not recognised in 1 min and boiler's thermostat is switched off.
	BURNING	Boiler thermostat is switched on, feeder auger has made less than 8 rotations and previous state was BURNING.
END BLOW	WAITING	Burning end. Feeder auger has made 15 + 10 rot and blowing time 60 sec is reached.
	STOPPED	Flame is not recognised in 1 min and burner is not switched on.
	NO FLAME	In Burning status flame misses more than 1 minute.
	LEVEL ERROR	In Burning status level of fuel in feeder's inlet doesn't decrease.
	NO PELLETS	No pellets recognised in feeder's inlet.
NO POWER	WAITING	Power exists and boiler's thermostat is switched off.
	STOPPED	Power exists and boiler's thermostat is not switched on.
	BURNING	If status before No Power was Burning and No Power didn't last more than 5 min.
Any other	WAITING	Boiler's thermostat is switched on.

7 Annex 1 Electrical diagrams

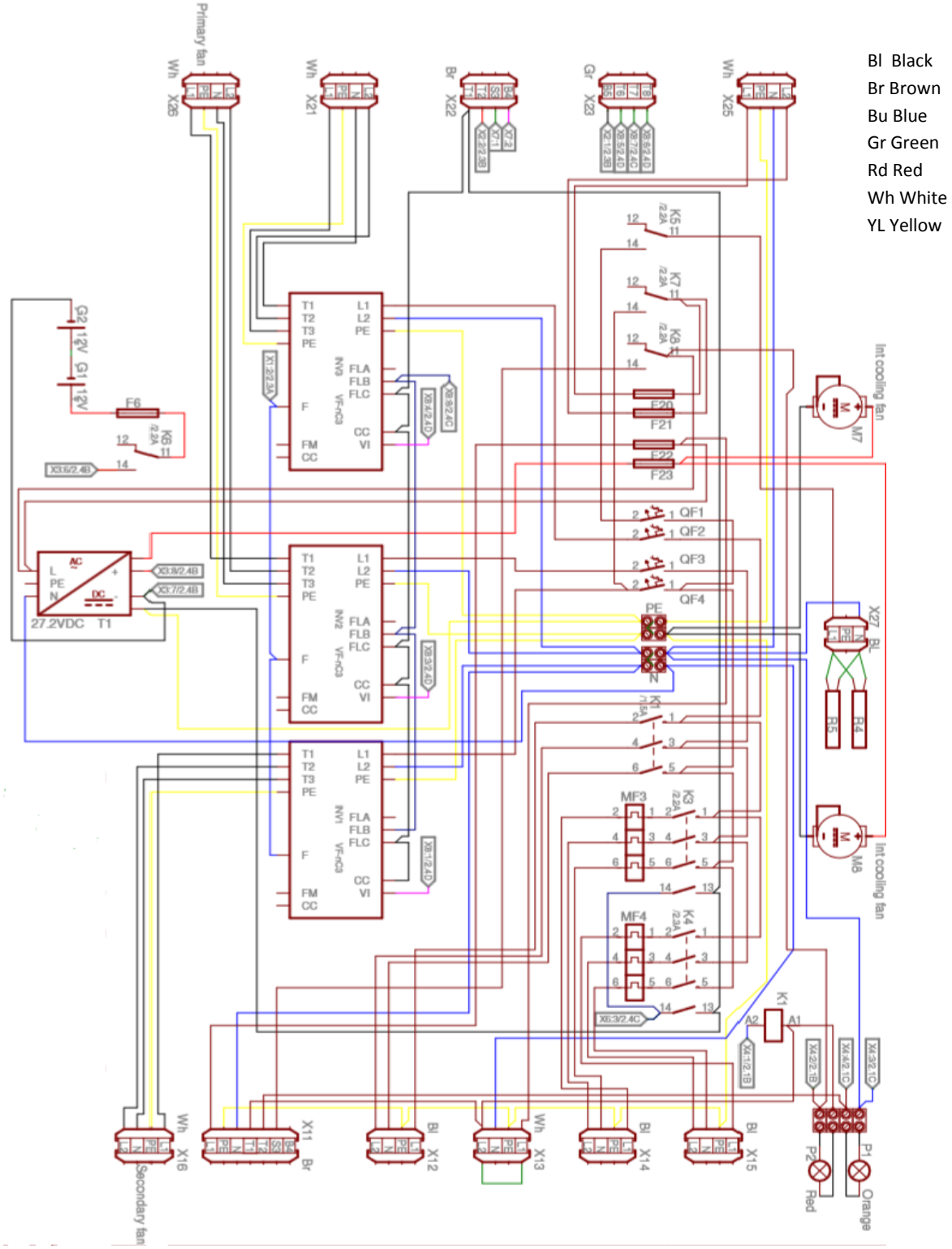


Figure 36 PV700 Electrical diagramm

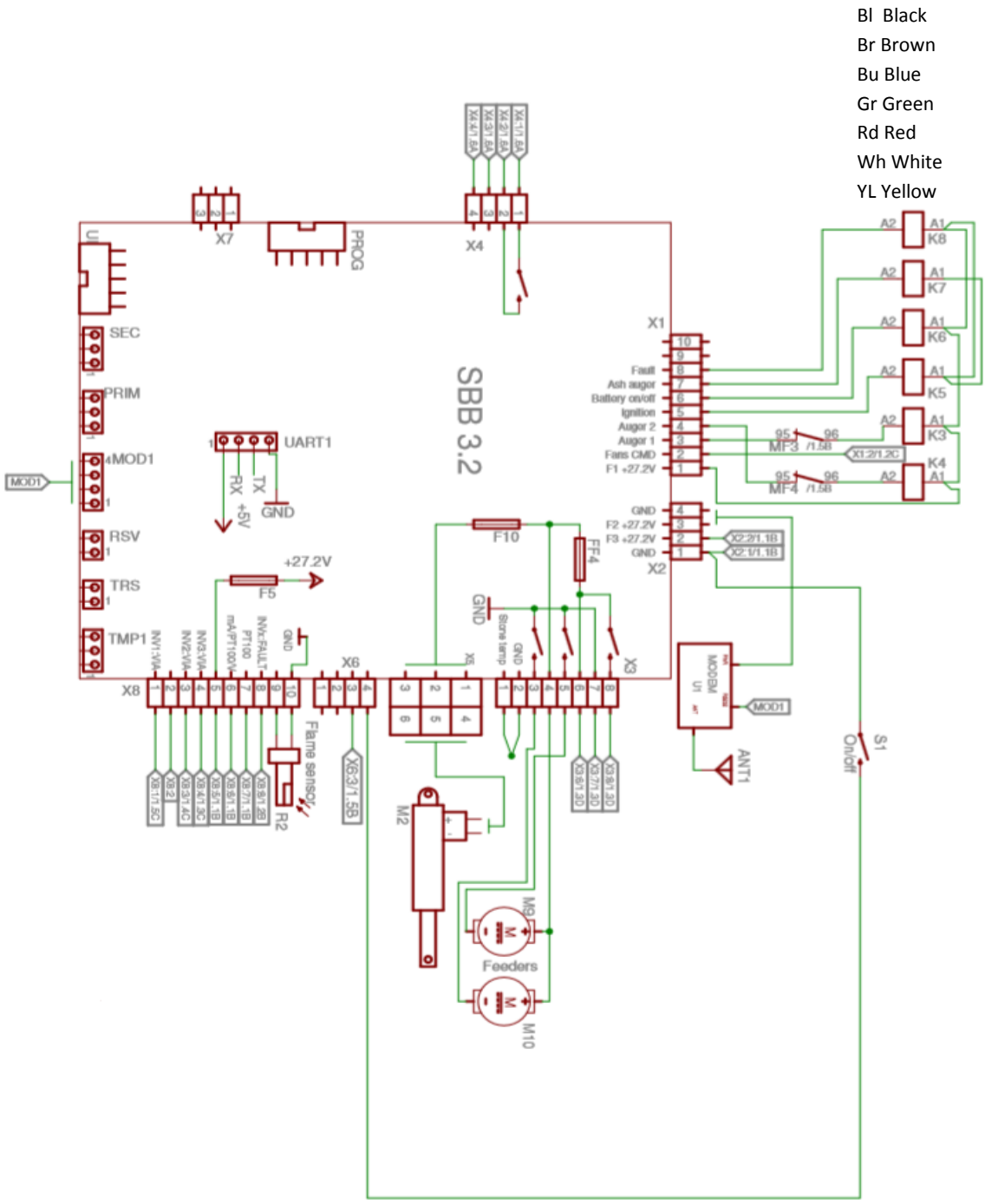


Figure 37 Principle diagram

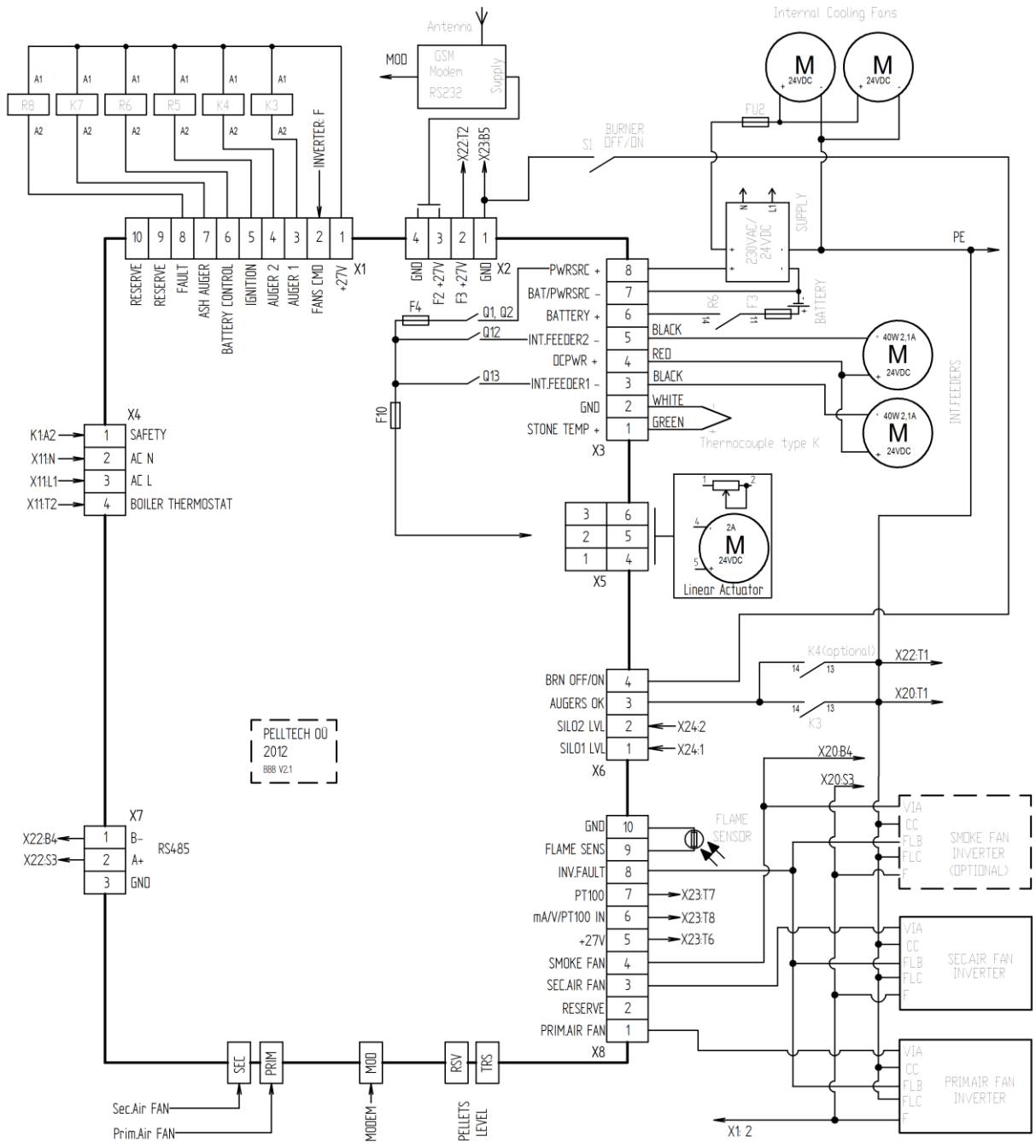
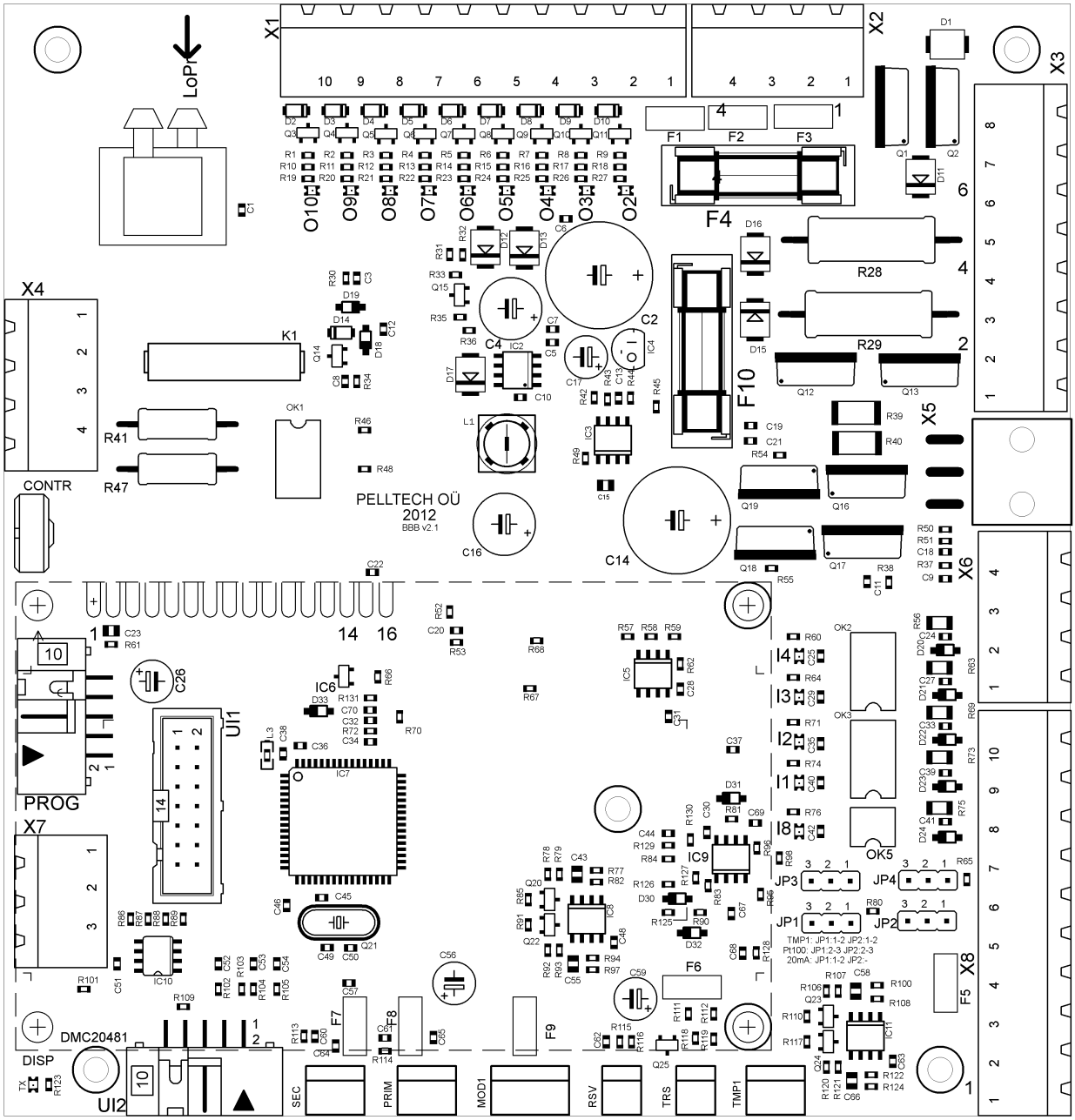


Figure 38 Principle diagram

8 Annex 2 – Controller board



Fuse F4=6A 24VDC Power supply

Fuse F10= 2A Linear motor

Figure 41 Controller board BBB v2.1

Table 23 Controller board connectors

Connector	Description
LoPr ←	Boiler pressure sensor connection. Must be connected to tube on left feeder tube.
FANx-1	Prim/sec fan speed sensor +5V power
FANx-2	Prim/sec fan speed sensor GND
FANx-3	Prim/sec fan speed sensor digital input
MOD1-1	Modem interface +5V output, fused through F9
MOD1-2	Modem interface Rx input
MOD1-3	Modem interface Tx output
MOD1-4	Modem interface GND
TMP1-1	Temperature sensor power +5V
TMP1-2	Temperature sensor GND
TMP1-3	Temperature sensor signal 0 – 2.5VDC
RSV-1	Level sensor receiver diode cathode
RSV-2	Level sensor receiver diode anode
TRS-1	Level sensor transmitter LED anode
TRS-2	Level sensor transmitter LED cathode
X1-1	+27VDC power output, fused through F1
X1-2	Open collector output, max 200mA, 30VDC
X1-3	Open collector output, max 200mA, 30VDC
X1-4	Open collector output, max 200mA, 30VDC
X1-5	Open collector output, max 200mA, 30VDC
X1-6	Open collector output, max 200mA, 30VDC
X1-7	Open collector output, max 200mA, 30VDC
X1-8	Open collector output, max 200mA, 30VDC
X1-9	Open collector output, max 200mA, 30VDC
X1-10	Open collector output, max 200mA, 30VDC
X2-1	GND
X2-2	+27VDC power output, fused through F3
X2-3	+27VDC power output, fused through F2
X2-4	GND
X3-1	+ Thermocouple input (fire brick temperature sensor)
X3-2	- Thermocouple input (GND)

X3-3	1st feeder motor black wire
X3-4	1st and 2nd feeder motors red wire (+27VDC power output)
X3-5	2nd feeder motor black wire
X3-6	Battery positive terminal
X3-7	GND
X3-8	+27VDC Power supply input
X4-1	Connects to X4-2 through K1
X4-2	AC supply N
X4-3	AC supply L
X4-4	Boiler thermostat (AC voltage)
X5-1	Grate cleaning motor position feedback
X5-2	GND
X5-3	not connected
X5-4	Grate cleaning motor
X5-5	Grate cleaning motor
X5-6	not connected
X6-1	DC input
X6-2	DC input
X6-3	DC input
X6-4	DC input
X7-1	MODBUS signal A
X7-2	MODBUS signal B
X7-3	MODBUS GND
X8-1	DAC 0 – 10V output
X8-2	DAC 0 – 10V output
X8-3	DAC 0 – 10V output
X8-4	DAC 0 – 10V output
X8-5	+27VDC power output, fused through F5
X8-6	PT100/mA/2.56V input. JP1 & JP2 selects function
X8-7	PT100/mA input, JP3 & JP4 selects function
X8-8	DC input
X8-9	Flame sensor input
X8-10	Flame sensor input

9 Annex 3 Control unit

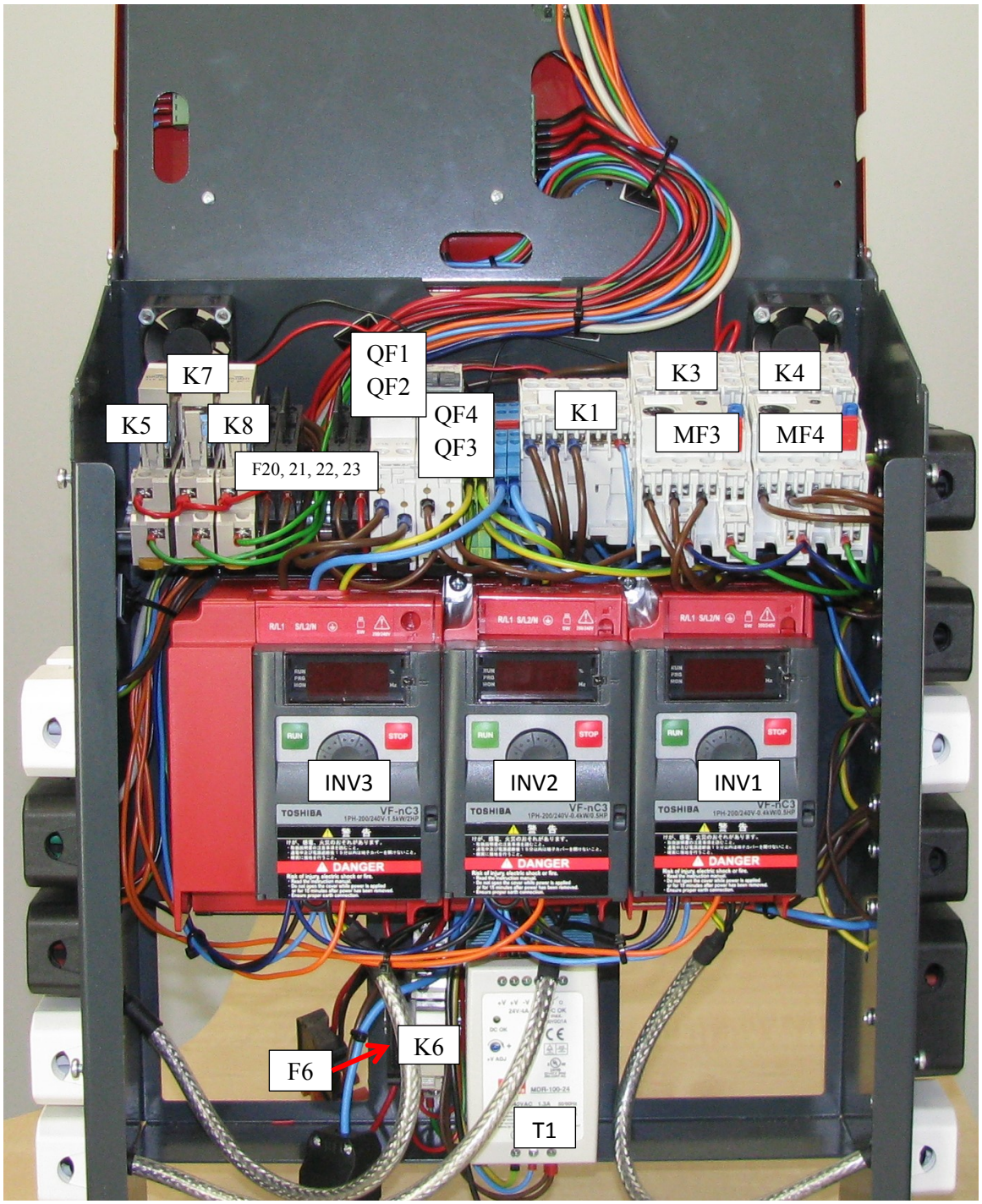


Figure 42 PV1000 contrtol unit

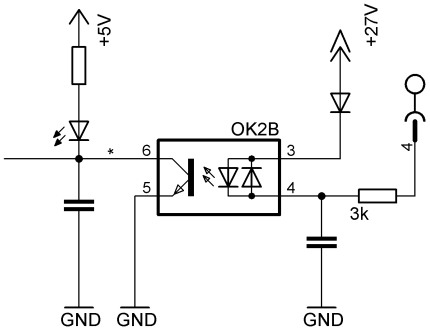


Figure 43 DC input circuit

Table 24 Names of components on Figure 40

Abr.	Description
INV1	Secondary fan's inverter
INV2	Primary fan's inverter
INV3	Flue gas fan (optional)
K1	Main power supply 3-pole contactor
K3	External auger 1 3-pole contactor
K4	External auger 2 3-pole contactor
MF3	External auger 1 3-pole motor protector
MF4	External auger 2 3-pole motor protector
K5	Igniters' contactor
K6	Battery on/off contactor
K7	Ash auger contactor
K8	Fault circuit
QF1	Igniters' 1-pole thermo-magnetic protector switch
QF2	INV3 L1 1-pole thermo-magnetic protector switch
QF3	INV2 L1 1-pole thermo-magnetic protector switch
QF4	INV1 L1 1-pole thermo-magnetic protector switch
T1	Power supply 230VAC/27,2VDC
F6	Battery's fuse 6A
F20	Ash auger's motor fuse 3A
F21	Ash scraper's motor fuse0,25A
F22	Control voltage X11 fuse1 A
F23	Cooling fan's motor fuse 1 A

10 Annex 4 Table of parameters

	Firmware version:	bbb: 2.08 22/11/13		PV700a			PV1000a		
PAR	**PAR Name**	**Description**	**Unit**	**Def**	**Min**	**Max**	**Def**	**Min**	**Max**
PAR1	FAN@200(250)	Fan speed at 1.power level PV700(PV1000)	rps	28	15	50	24	15	50
PAR2	FAN@300(400)	Fan speed at 2.power level PV700(PV1000)	rps	32	15	50	30	15	50
PAR3	FAN@400(550)	Fan speed at 3.power level PV700(PV1000)	rps	34	15	50	34	15	50
PAR4	FAN@500(700)	Fan speed at 4.power level PV700(PV1000)	rps	37	15	50	38	15	50
PAR5	FAN@600(850)	Fan speed at 5.power level PV700(PV1000)	rps	40	15	50	42	15	50
PAR6	FAN@700(1000)	Fan speed at 6.power level PV700(PV1000)	rps	42	15	50	45	15	55
PAR7	FAN START	Fan speed at TESTING	%	170	80	240	170	80	240
PAR8	FAN@IGNITING	Fan speed at IGNITING and PRE-BURN	rps	20	15	35	20	15	35
PAR9	FAN@END BURN	Fan speed at END BURN	rps	20	10	40	20	10	40
PAR10	FAN@HOLD FLAME	Fan speed at HOLD FLAME	rps	10	7	14	10	7	14
PAR11	HOLD FLAME ON	If HOLD FLAME is set to ON in main menu then this function starts at any case. If HOLD FLAME is set to AUTO in main menu, then this function starts if time set with this parameter is shorter than 2 sequential WAITING times.	min	15	5	30	15	5	30
PAR12	HOLD FLAME OFF	Max time when burner holds flame. HOLD FLAME function in main menu has to be set to AUTO or ON.	min	60	30	90	60	30	90
PAR13	MIN POWER	Minimum power level up to what burner decreases output power. Applies if POWER in main menu is in AUTO status only	kW	200	200	700	250	250	1000
PAR14	MAX POWER	Maximum power level up to what burner decreases output power. Applies if POWER in main menu is set to AUTO only	kW	700	200	700	1000	250	1000
PAR15	POWER UP	Timeframe to burner to increase power to one level up if BURNING state lasts longer than set with this parameter. Applies if POWER in main menu is set to AUTO only	min	15	5	120	15	5	120
PAR16	POWER DOWN	Timeframe to burner to decrease power to one level up if BURNING state lasts longer than set with this parameter. Applies if POWER in main menu is set to AUTO only	min	30	15	45	30	15	45
PAR17	UP CYCLE	Pace of increasing targeted power level part-steps	min	2	1	3	2	1	3
PAR18	DOWN CYCLE	Pace of decreasing targeted power level part-steps	min	2	1	3	2	1	3
PAR21	PELLETS NORMAL	Determines how many grams of pellets feeder auger transports to burning chamber with one full rotation when PELLET NORM ie normal weight pellets are selected	g/rot	160	120	250	160	120	250

PAR22	PELLETS LIGHT	Determines how many grams of pellets feeder auger transports to burning chamber with one full rotation when PELLET LIGHT ie lighter than normal weight pellets are selected	g/rot	150	120	250	150	120	250
PAR23	PELLETS HEAVY	Determines how many grams of pellets feeder auger transports to burning chamber with one full rotation when PELLET HEAVY ie heavier than normal weight pellets are selected	g/rot	170	120	250	170	120	250
PAR24	LOADING FEED	Number of feeder auger rotations in LOADING state	rot	40	20	80	40	20	80
PAR25	LOADING 2 FEED	Number of feeder auger rotations in LOADING2 state	rot	5	1	15	5	1	15
PAR26	END BURN FEED	Number of feeder auger rotations in END BURN state	rot	70	40	120	80	20	120
PAR27	END BLOW TIME	Fan's END BLOW time after flame has disappeared	sec	2	1	15	2	1	15
PAR30	FAN 2	Secondary fan On//OFF control (not used in PV50b)	1/2	3	1	3	3	1	3
PAR31	FAN 2@200(250)	Secondary fan speed at 1.power level PV700(PV1000)	rps	13	5	80	16	5	40
PAR32	FAN 2@300(400)	Secondary fan speed at 2.power level PV700(PV1000)	rps	23	5	80	22	5	50
PAR33	FAN 2@400(550)	Secondary fan speed at 3.power level PV700(PV1000)	rps	32	5	80	30	5	55
PAR34	FAN 2@500(700)	Secondary fan speed at 4.power level PV700(PV1000)	rps	39	5	80	38	5	55
PAR35	FAN 2@600(850)	Secondary fan speed at 5.power level PV700(PV1000)	rps	41	5	80	42	5	55
PAR36	FAN 2@700(1000)	Secondary fan speed at 6.power level PV700(PV1000)	rps	43	5	80	46	5	55
PAR38	FAN 2 BASE	Changing amount of secondary fan base air with flue gas fan speed setting in all power levels	%	100	65	140	100	65	140
PAR39	FAN 2 MIN	Secondary fan minimal speed	rps	7	5	20	7	5	20
PAR40	PHOTOCELL LEVEL	Flame sensor sensitivity. Higher number means that flame is recognized when less light	%	90	50	100	90	50	100
PAR41	PRE-BURN TIME	Length of one PRE-BURN cycle state	sec	25	15	80	25	15	80
PAR42	PRE-BURN CYCLES	Number of PRE-BURN cycles. Total length of PRE-BURN cycles is length of one cycle times number of cycles	X	6	2	10	6	2	10
PAR46	FEED CURRENT	Preset feeder auger motors current. Overcurrent protection threshold	A	6	1	9,9	6	1	9,9
PAR47	GRATES CURRENT	Grate motor overcurrent protection threshold	A	2	0,2	6	2	0,2	6
PAR48	CLEANING CYCLE	Pre-set time between two cleaning cycles 0=CLEANING OFF	min	30	0	250	30	0	250
PAR50	RELAY ERROR	ERR output function selection	1/2	1	1	2	1	1	2
PAR52	SMS COUNT	Selecting number of phones receiving alert SMS	X	1	0	5	1	0	5
PAR53	TEMP.TYPE	Determines temperature sensor type plugged in TMP1 connector	-	0	0	10	0	0	10
PAR54	TEMP.LEVEL	Set point value for temperature sensor plugged to TMP1	°C	70	30	200	70	30	200
PAR55	TEMP.HYST	PAR54 maximum set point hysteresis	°C	5	2	10	5	2	10

PAR58	BASE FREQUENCY	Grid frequency	Hz	50	45	63	50	45	63
PAR60	FLUE GAS TYPE	Flue gas fan ON-OFF turning 0 OFF 2 ON	-	2	0	2	2	0	2
PAR61	DRAFT SET	Flue gas fan pre-set pressure set point	-Pa	8	0	250	8	0	250
PAR62	DRAFT ERROR	Draught error threshold value	+Pa	10	0	20	10	0	20
PAR63	DRAFT BASE	Draught sensor calibration value	%	110	50	150	110	50	150
PAR66	OXYGEN TYPE	Type of oxygene sensor: 0 no sensor; 1 4..20mA=0..25%; 2 4..20mA=0..20%	-	0	0	2	0	0	2
PAR67	OXYGEN SET	Oxygen level setpoint	%	6	4	14	6	4	14
PAR70	HEAT UP TIME	Initial heat up time for burners with ceramic burning chamber	min	20	0	60	20	0	60
PAR71	HEAT UO POWER	Initial heat up power for burners with ceramic burning chamber	kW	5	1	10	7	1	15
PAR72	HEAT UP TEMP.	Initial heat up temperature for burners with ceramic burning chamber	-	50	25	90	50	25	90
PAR73	TEMP BASE	TEMP BASE	-	20	0	100	20	0	100
PAR99	BURNER TYPE	Selecting model of burner. Software of wrongly selected model works incorrectly	-	700	20	1M	1M	20	1M

11 Annex 5 Table of languages

	Language
ENG	English
SPA	Spanish
EST	Estonian
FIN	Finnish
FRA	France
GER	Germany
GRE	Greece
HRV	Croatian
LIT	Lithuanian
LAT	Latvian
NED	Dutch
POR	Portuguese
RUS	Russian
SLO	Slovenian
SRB	Serbian
SVK	Slovakian
SWE	Swedish

Warranty

Warranty objects in this context are pellet burner PV700 or PV1000 and supplied auger.
Producer gives 2 years warranty from the date of sale for the PV 700 or PV 1000 burner and supplied auger.

Exception is ignition element (igniter), for this item warranty is 1 (one) year.

Warranty is valid when user had not made changes in the construction and setup of the burner.

Warranty does not cover defects caused by an accident, misuse, abuse, improper installation or operation, lack of reasonable care, unauthorized medication, loss of parts, tampering, attempted repair by a not authorized person, mains errors or using poor quality fuel.

Warranty is valid only if the bottom half of the warranty ticket is filled in and sent or brought to the office of Pelltech OÜ Sära tee 3, Peetri, Rae vald, 75312 Harjumaa ESTONIA

Ph.. + 372 677 5277
www.pelletikeskus.ee
info@pelltech.ee

Warranty ticket

Burners model	**PV700 or PV1000**
Product number	……
Sales date	……
Installation/commissioning date	……
Owners contacts	Installers name and signature
Name ……	……
Phone nr ……	……
City/village ……	
Street/ House ……	

……Cut here!……

Warranty ticket

Burners model	**PV700 or PV1000**
Product number	……
Sales date	……
Installation/commissioning date	……
Owners contacts	Installers name and signature
Name ……	……
Phone nr ……	……
City/village ……	
Street/ House ……	

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